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THE

AMERICAN

JOURNAL OF PSYCHOLOGY

EDITED BY

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VOL. XIII.

CLARK UNIVERSITY, WORCESTER, MASS.
LOUIS N. WILSON, Publisher.
1902.

TABLE OF CONTENTS.

FLORENCE WINGER BAGLEY,
An Investigation of Fechner's Colors, ... 488-525

SANFORD BELL,
A Preliminary Study of the Emotion of Love between the Sexes, ... 325-354

I. MADISON BENTLEY,
The Psychology of Mental Arrangement, . . 269-293

EDWARD FRANKLIN BUCHNER,
Fixed Visualization: Three New Forms, . . 355-363

STEPHEN S. COLVIN,
The Psychological Necessity of Religion, . . 80-87

CLEMENS J. FRANCE,
The Gambling Impulse, ... 364-407

REVERE RANDOLPH GURLEY,
The Habits of Fishes, ... 408-425

SAMUEL PERKINS HAYES,
An Historical Study of the Edwardean Revivals, . 550-574

A. J. KINNAMAN,
Mental Life of two *Macacus Rhesus* Monkeys in Captivity, ... I, 98-148; II, 173-218

O. G. LIBBY,
The Bird Lover as a Scientist, ... 457-476

ROBERT MACDOUGALL,
Rhythm, Time and Number, ... 88-97
Minor Investigations in Sense Perception, . . 477-487

W. B. PILLSBURY,
Studies from the Psychological Laboratory of the University of Michigan, ... 1-27

EDMUND CLARK SANFORD,
Mental Growth and Decay, ... 426-449

CHARLES H. SEARS,
A Contribution to the Psychology of Rhythm, . . 28-61

J. W. SLAUGHTER,
The Moon in Childhood and Folk-lore, . . . 294-318
A Preliminary Study of the Behavior of Mental Images, 526-549

XI, p. 393] in referring to the curve of plotted judgments notes " distinctly longer or primary waves " which appeared in all of his results, and which seemed independent of the length of interval. The length of these primary waves was from 0.6 to 0.9 minutes. These rhythmical variations he thinks are due to rhythmical changes in the " standard carried about in the mind" of the subject. In explanation of the variations he says, p. 401, "That this is connected with the rhythmical changes in the nutritive condition of the cerebral centers, as produced by vaso-motor rhythmical constriction of the arterioles, it would be rash to deny or affirm, or, perhaps, even to suppose." In addition to the problem as already stated, there are two other points that have come in for consideration, namely, the determination of the course of the constant error and the question of the validity of Weber's Law. There are also several minor points that will be discussed as they present themselves.

2. *Method.* The method of Average Error, as given by Külpe was used in this study. There have been numerous objections to this method as applied to the estimation of time intervals, chief of which is that of Glass [Phil. Stud., IV, p. 423, Kritisches und experimentelles über den Zeitsinn], who was the first to use the method extensively after Vierordt. In criticising the method he gives three sources of error that tend to increase the constant error beyond its true value. "Diese Zeit setzt sich aus mehreren Elementen zusammen, nämlich erstens aus jener Zeit welche vergeht, um von dem Urtheil dass die Fehlzeit der Normalzeit gleich sei, zu dem Entschluss übergehen, den Gang des Uhrwerkes zu hemmen: dazu kommt zweitens die Zeit, welche nötig ist, den Bewegungimpuls auszulösen und bis zum Muskel fortzupflanzen, und drittens wird noch Zeit verbraucht um den Hebel zu verrüchen, wenn diese letztere Zeit auch nur einen sehr kleinen Bruchtheil einen Secunde beträgt. Da alle Fehlzeiten um T zu gross sind, so wird der constante Fehler in Wahrheit gleich $c - T$ und also $\Delta = c - T$ sein." And in another place he says that, at times, it may become as large as $\frac{1}{20}$th of a second.

If this criticism were valid, the method of Average Error would have to be abandoned for the estimation of time intervals, at least; but that it is not true is clearly proved by the work of F. Martius [Weitere Untersuchungen zur Lehre von der Herzbewegung. Zeitschrift für klinische Medicin, XV, p. 536] in an investigation to demonstrate the ability of a person to register the beats of the heart, precisely at the moment of hearing them, by the "akustischer Markmirmethode." In an earlier paper [Vol. XIII, same Journal], Martius attempted to ascertain what point in a cardiogram corresponded to a given sound in the heart cycle. This he attained by recording, with a tap of the finger, the point on the curve which corresponded to a given sound in the heart beat. In criticism of his work it was maintained by some that the movement of the finger could not be made simultaneously with the sound impression; but that there would be a difference in time between the hearing of the sound and the recording movement equal to the person's reaction time.

Martius's second paper is a reply to that objection. With the result, as he shows, that one has the ability to record a continuous series of sound impressions practically without error; the error varies between 0.04″ and 0.017″, and is very often zero. Furthermore, it must be remembered that the normal heart beat is a variable stimulus and, undoubtedly, accounts for much of the error. It seems certain, therefore, that the threefold error mentioned by Glass cannot be considered well founded.

The advantages of the reproduction method lie (1) in the immediate results of the estimation which it gives: obviating the error of indirect sensible discrimination. (2) It allows a more complete surrendering of the subject to the rhythm of the sound impressions. (3) And most important of all for our own problem is the continuous series of judgments which it permits without interruption, Such a series was absolutely essential for the problem in hand in order to afford a direct comparison of the series of plotted judgments and the parallel series of vaso-motor waves.

3. *Apparatus.* The apparatus in its essentials consisted of the following parts: (1) A large smoked drum, driven by a half kilowatt electric motor. (2) A tuning fork of 50 double vibrations per second. This was kept in vibration by a storage battery. (3) A Meumann Time Sense Instrument. (4) A clock-work kymograph for recording the normal interval, pneumogram and plethysmogram. (5) A telegraphic sounder. (6)[1] A finger plethysmograph. (7) A Fitz pneumograph.

There were three separate electrical circuits connecting the different parts of the apparatus, a description of which will make the workings of the apparatus, as a whole, more clear. (1) From the Time Sense Instrument to the telegraphic sounder, and thence by a shunt to a time marker which wrote upon the clock-work kymograph. This circuit was supplied by a battery of two bichromate cells. The Time Sense Instrument is supplied with adjustable contacts [two, only, were used in the experiments] to which one pole of the battery was attached. The circuit was completed by the instrument itself. The contacts, above referred to, are insulated so that the circuit is made and broken by the revolution of a metal rod. [For a detailed description of the Time Sense Instrument see Meumann, Phil. Stud., IX, pp. 270-274.] There are five pulleys on the instrument so that rates of rotation varying between fairly wide limits could easily be obtained. This, together with the different positions of the electrical contacts upon the graded circle of the instrument, admitted of all intervals of the lengths desired. The shunt in this circuit from the sounder to the time marker on the kymograph was put in for the purpose of having some constant point of reference for the plethysmograms and pneumograms. Thus, the relation of any given normal interval to the plethysmographic or pneumographic curves could easily be obtained. And conversely any point in the blood volume or respiratory records could readily be referred to its exact place in the series of normal clicks. Furthermore, as the rate of the drum on which the normal was reproduced was much faster than the kymograph on which the plethysmograms and pneumograms were recorded, the record of the normal interval on the latter drum made the work of plotting the judgments taken from the former drum easy and accurate. (2) A circuit, supplied by one bichromate cell, from the telegraphic sounder to a time marker which wrote upon the large drum. There was also a shunt circuit from the sounder to a key beside which the subject sat, and by which he reproduced the normal interval by a slight tap of the finger. From this it will be seen that one and the same signal served both to record the normal interval and the subject's judgment. The key was provided with a spring which immediately broke the circuit after the removal of the finger. (3) A circuit from the storage battery to the tuning fork and a shunt circuit in which was a resistance box, connected the tuning fork with the second time marker which wrote the time in fiftieths of a second on the large drum just above the curve of normal interval and reproductions.

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[1] Amer. Jour. of Physiol., Dec., 1899.

4. *Practice and Proceedure.* Of the six persons used in this experiment but two were practiced in the estimation of intervals, although all were experienced in psychological work. With the shorter intervals no preliminary practice was considered necessary, but with intervals 0.92″ to 7.24″ a period of practice immediately preceded the regular experiments. The hour of experiment was 1 P. M. The general proceedure was as follows: The subject was comfortably seated beside a table so that his fingers hung just above the key by which his judgment was recorded. The middle finger of the left hand was thrust into the plethysmograph which was suspended from the ceiling by a cord. In the later experiments [Intervals 2.40″— 7.24″] a pneumograph was attached to the thorax of the subject and adjusted to write

upon the clock-work kymograph. The telegraphic sounder, the clicks of which limited the normal interval, stood upon the same table and behind the reagent. The clock-work kymograph stood near by, beside which an assistant sat who attended to it and to the writing of the plethysmograph and pneumograph. The large drum, Time Sense Instrument, tuning fork and motor were in an adjoining room, all connections with the other parts of the apparatus passing through the wall. There was considerable noise made by the motor; but as it was in the nature of a muffled roar of constant pitch and approximately constant intensity it formed a background as it were, for the two clicks of the normal, without, in any way, tending to "drown them out." Hence it was neglected. Two seconds before the motor was started the preparatory "ready" was called out by the assistant attending that part of the apparatus. The motor was then started, and also the clock-work kymograph in the other room. As the revolving rod of the Time Sense Instrument passes the two contacts the sounder emits two sharp clicks. The subject is to press the key at the moment he thinks that a time has elapsed equal to that between the two clicks of the sounder. Then follows the same sequence of the normal clicks and the tap on the key as before until the drum has exhausted itself. The subject is then allowed to rest while the drum is again prepared and a like series gone through with. The method of single reproduction, as above described, was not adopted until after interval 0.72″. Before that, a method of multiple reproduction was followed. The normal interval was given as already described; but the subject instead of dating his judgment from the second click of the normal, made *two* taps upon the key as the limits of the time interval. There was thus left a time interval between the last click of the normal interval and the first tap of the reproduction. With very short intervals when the contacts were close together there remained a considerable interval before the revolving rod completed its revolution. To take advantage of this the subject was told to make as many reproductions of the normal interval as he conveniently could. This, however, proved detrimental, as some of the subjects persisted in "hurrying" the last judgments, although cautioned against it. The number of reproductions, therefore, was limited to three, before this method was abandoned for that first described. The effect of both multiple and single reproductions upon the length of judgment will be discussed more fully under the head of "Constant Error." With the change in the number of reproductions the two contacts of the time sense instrument were placed 120° apart, and not changed during the remainder of the work. All changes in the length of interval were effected by means of the belts and pulleys. The result of this is, that the two normal intervals recur at precisely the same point, with reference to the complete revolution, for any interval. They thus tend to fall into a definite rhythm, which is kept constant for all the intervals worked with.

5. *Review of Meumann and Shaw and Wrinch.* Nichols [*Amer. Jour. of Psych.*, Vol. III] has given a complete review of the literature of the subject up to eighteen ninety-one. Meumann has reviewed the later work of Münsterberg and Schumann. We will give, therefore, a brief statement of the results of work that still remains unnoticed.

Meumann: The work of E. Meumann makes a turning point in the nature of Time Sense investigation. Previous to him the general character of the work was very decidedly quantitative. That this is the case is very clearly shown by only a slight acquaintance with the literature of the subject. For example, Kollert and Estel formulated mathematical laws for the course of the constant error. Mach investigated only the question of the validity of Weber's Law. And Fechner's criticism of Estel is very largely a discussion of methods and an interpretation of symbols. In contradistinction to work of this kind Meumann's point of view is pre-eminently qualitative. The object of his investigation is to show the effect of the different intensities of the limiting stimuli on the apparent length of intervals and the deceptions of judgments due to different kinds of "fillings."

There are three articles that deal directly with the estimation of intervals. (1) Beiträge zur Psychologie des Zeitsinnes [Phil. Stud., VIII, p. 431], which is a critical review of the literature of the subject, with particular attention to Münsterberg and Schumann. (2) [Phil. Stud., IX, p. 264.] A continuation of the former article, though this is wholly experimental. (3) Beiträge zur Psych. des Zeitbewusstseins [Phil. Stud., XII, p. 128], which is an experimental investigation into the effect of different kinds of fillings upon the estimation of intervals.

As a general result of the first experimental work [Vol. IX], Meumann concludes that the estimation of intervals falls into three classes. (1) Very short intervals up to 0.5″, the judgment of which is very largely determined by the quality—intensity nature of the limiting stimuli. (2) Intervals of medium length — 0.5″ to 3.0″—which are estimated directly. The only basis of judgment is the interval of time itself. (3) Long intervals — 3.0″ and above — which are estimated indirectly by the mediation of some organic function. Meumann also points out the fact that, if, in a series of clicks of equal intensities, one more intense than the others, is sounded, the interval preceding it is apparently shortened. And, in general, it may be said that an intense limiting stimulus shortens the length of the interval preceding it, while a weak stimulus apparently lengthens it.

The general results of the second experimental article [Vol. XII] on the effect of the kind of filling on the estimation of a time interval are recapitulated on p. 247 in the concluding remarks from which I quote.

(1) "Unsere Zeitschätzung ist in hohem Masse abhängig von der Art der Ausfüllung der Zeitstrecken."

(2) "Diese Abhängigkeit äussert sich in ganz verschiedener Weise bei kleinen, mittleren und grösseren Zeiten."

(3) "Werden zwei different ausgefüllte Zeitstrecken miteinander verglichen, von denen die erste eine reizerfüllte, die zweite eine "leere" reizbegrenzte ist, so erscheint bei kleinsten und kleinen Zeiten die reizerfülte Zeit grösser wie die reizbegrenzte Zeitstrecke; bei grossen Zeiten tritt das Umgekehrte ein, die reizerfüllte Zeit erscheint kleiner wie die reizbegrenzte. Zwischen diesen beiden Richtungen der constanten Fehlschätzung unter dem Einfluss differenter Ausfüllung lässt sich fast immer eine Indifferenzzone nachweisen, innerhalb deren die different ausgefüllten Zeitstrecken gleich oder annähernd gleich erscheinen, innerhalb deren also weder Ueber—noch Unterschätzung einer von beiden Zeitstrecken herrscht."

(4) The influence of the number of filling impressions is more strongly marked with small times. With both visual and auditory stimulation the quality of overestimation increases with the number of filling sensations so long as they are not carried to a point of fusion.

(5) These rules hold good in whatever sense department the limiting stimuli are.

Shaw and Wrinch. The latest work that has been done in Time Sense is "A Contribution to the Psychology of Time," by M. A. Shaw and F. S. Wrinch [Univ. of Toronto, Studies Psych., Series No. 2, 1898-1900]. The work is divided into five sections. (1) An Historical Sketch of the Problem. (2) Theory of Time Estimation. (3) Experiments on the Lapse of time between the normal and comparative intervals. (4) Weber's Law and Time Estimation. (5) Reproduction of complex rhythmically-arranged groups of interval. This work undoubtedly suffers from the fact that a preconceived theory of time estimation is allowed to influence the experiments. The theory is, that there is in consciousness a "unit of time" which serves as the basis of all time estimation. This unit is equivalent to "the interval that lies between the short and long groups, which has been found to be the most accurately estimated interval. It differs in length more or less in different individuals, but in all cases the constant error and mean variation are less as we approximate to it. Here, neither the limiting impression, which influences the judgment of the shorter intervals, nor the originally functioned content which influences the judgment of longer intervals, modifies the estimation to any marked degree. This remarkable fact, in connection with the estimation of intervals, that a more or less definite interval is estimated most accurately, and the further fact that as we depart from it in either direction errors arise in judgment, lead us to believe it to be the basis of the estimation of intervals in all cases—a temporal unit."

The justification for the theory is that it satisfies the demands "fundamental in the human mind" for "single principles," and also the "scientific demand for explanation by as few principles as are consistent with the facts." p. 18.

The experimental basis of the theory rests (1) upon the statements of Külpe, Meumann and others, that there is an interval of medium length—0.5" to 3.0"—which is judged immediately. (2) That intervals less than the indifference time are overestimated. "This error in estimation seems to be due to the tendency of the unit to complete itself, it being the individual basis of estimation." (3) With the estimation of intervals longer than the indifference interval, the organic functions, already mentioned, serve, at least, as helps to judgment. "The explanation is not, however, that the content is the basis of judgment, but that the mind estimates intervals longer than the unit in terms of the unit itself, and that the unit or the multiple of it, is here represented by some regularly recurring organic function." (p. 20.) Although one would expect some individual variations of the unit, the differences between the length of the indifference interval as given by Külpe 0.5"—3.0" and those determined by their own experiments are very wide. Thus they say K's "unit of time" is "probably not much above 225σ". W's is 150σ and S's 189σ. pp. 42-43.

The third section of the work, the experimental part, is to show the effect of a lapse of time between the normal and comparative intervals. In these experiments visual stimuli were used. The source of light was an incandescent lamp reflected by means of a mirror through holes bored in a band attached [illegible] kymograph. The subject sat fifteen feet away, and re- [illegible] telescope. As the drum revolved, [illegible] marked the interval. The inter- [illegible] subject "by means of a rigid steel [illegible] observer held between his fingers [illegible] and a pulley, was connected with a pointer in contact with the paper." p. 126. The time was recorded upon the drum in hundredths of a second by means of a tuning fork. The average error, constant error and mean variation are worked out.

The results are quoted literally, p. 130. (1) The interval of half a second approximates to what has been called above the unit of time. . . . . Here, also, the effect of the pause is less than with intervals above it. The mean variation is the same for immediate [judgments] and "one minute," while the constant error is nearly the same for both. (2) With intervals above the unit of time the mean variation increases with the length of the pause. Sensibility decreases with intervals above the unit. (3) The constant error is practically the same throughout for "one minute" and "immediate." (4) After the lapse of half a minute the results are not regular: with the longest normal interval [153.66 hundredths of a second] the constant error is less than for the "immediate," but with the other normal intervals it is greater. The mean variation for a half minute is greater than for "immediate."

In the work upon Weber's Law and, incidentally, to show the effect of different intensities of the limiting stimuli, auditory stimulation was used. The normal intervals varied in length from 93σ to 9150σ. I give the results below in two columns. (1) The length of normal interval and (2) the fraction of Weber's Law, *i. e.*, the "mean variation of the percentages of mean variations" are given in average for six to ten normal intervals. I quote the results of several subjects using the most favorable result, as in some cases two results are given.

SUBJECT.	NORMAL.	M V OF %S M V'S.
K	122– 257σ	0. 81%
	93– 187σ	0. 82%
	503–9050σ	0. 99%
W	101– 187σ	0. 72%
	131– 248σ	0. 67%
	512–9825σ	0.727%
S	107– 214σ	0. 62%
	500–8870σ	1. 50%
B	99– 254σ	1. 34%

From these results the authors conclude that it speaks "very conclusively for the validity of Weber's Law." It should be pointed out, however, that part of the results, at least, were made from auditory stimulation of varying intensities and the remainder with visual stimulation. It seems rather remarkable that the results agree as closely as they do, considering the very different experimental conditions under which they were de-order to ensure exact coincidence of the plotted curve and the plethysmogram, the millimeter paper was placed upon the plethysmographic record and the series or normals, as recorded on that drum, marked upon the millimeter paper. The judgments as they were obtained from the other drum in fiftieths of a second—multiplied by two to give hundredths—were numbered to correspond to the series of normals as recorded on the plethysmogram. So that there was no chance for error in the direct comparison of the two series. The judgments in hundredths of a second, one millimeter to one one-hundredth of a second, were laid off on the ordinate. To save space some number which was less than the smallest judgment was subtracted from all judgments of a given series before plotting. Thus only the absolute fluctuations appeared in any plotted curve. By this means curves to the number of thirty-seven were obtained which had parallel plethysmographic records with well defined vaso-motor waves in some part of their course.

As a result of the direct comparisons we have selected six curves which show coincidences of the vaso-motor wave and the fluctuations in judgment. The normal intervals from which they were derived, vary in length from 0.4″ to two seconds.

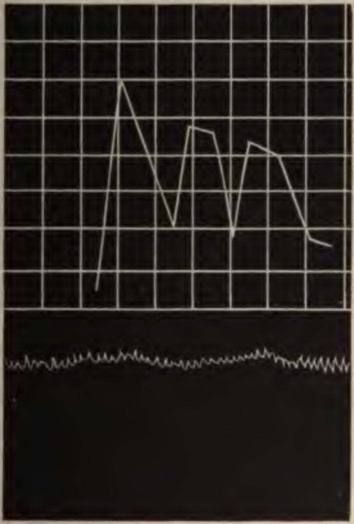

Fig. 1. Sr. subject. Interval N=0.66″. Curve reads from left to right.

The agreement of the three waves in each case of the two curves could hardly be bettered. The troughs of the curve of judgments exactly coincide with the troughs of the waves in the plethysmogram. Although the vaso-motor waves are not

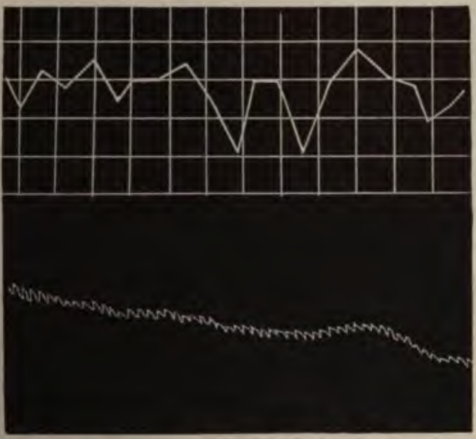

Fig. 3. Bt. subject. Interval 0.40″. Curve reads from left to right.

The interval from which these curves were derived was the first one of which single reproductions were made. The same deviation in the curve of judgments occur as in the others, although there is not much regularity. There are two well marked vaso-motor waves with corresponding rises in the curve of judgments. Between the two, however, is a short symmetrical rise and fall which agrees with a very slight rise in the plethysmogram between the two large vaso-motor waves before mentioned.

The plethysmogram in this case (see Fig. 4, p. 14,) is notable for the well marked and continuous series of vaso-motor waves. On the other hand, the variations in the curve of judgments are well marked but not very regular. In addition to the larger fluctuations there are many smaller ones which make it appear more or less broken. Of the eight vaso-motor waves that appear in this figure six have direct coincidences with the crests of fluctuations in the curve of judgments. On the other hand, the highest point in the estimation curve corresponds to the lowest of the plethysmogram. The remaining vaso-motor wave has no direct agreement with a rise in the judgments. This curve is also notable for the fact that it admits of direct comparisons for a longer period of time than any of the other curves.

As is shown in Fig. 5, p. 15, the fluctuations in the estimation curve are much larger than those previously exhibited. Although the agreement between the two curves can hardly be said to be exact, yet there is some coincidence, and what is more, the curve shows as many others did, though no direct comparison could be made, that where the changes in the ple-

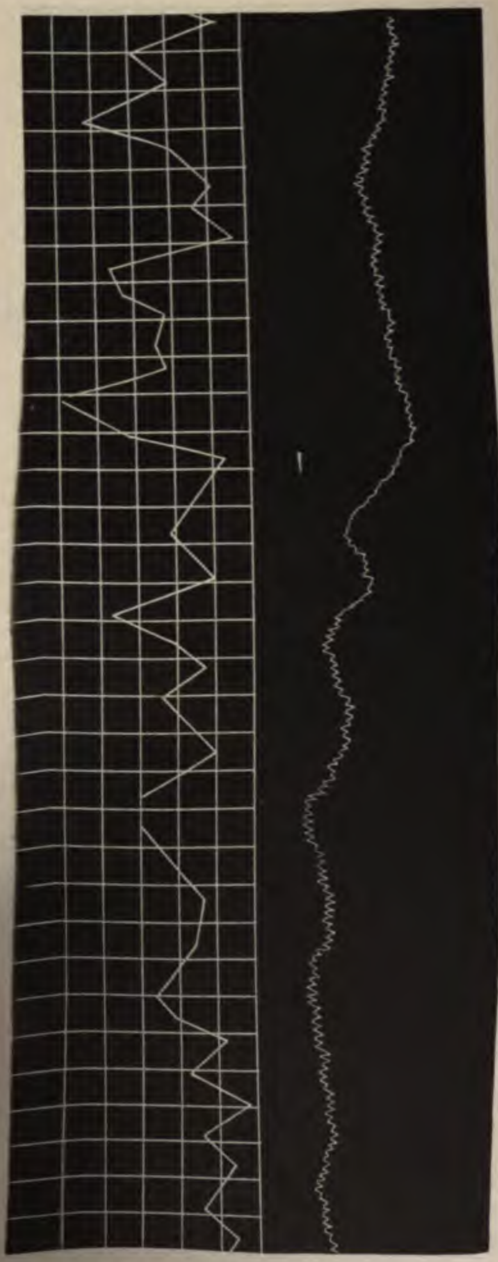

Fig. 4. Bt. subject. Interval 0.92″. Curve reads from left to right.

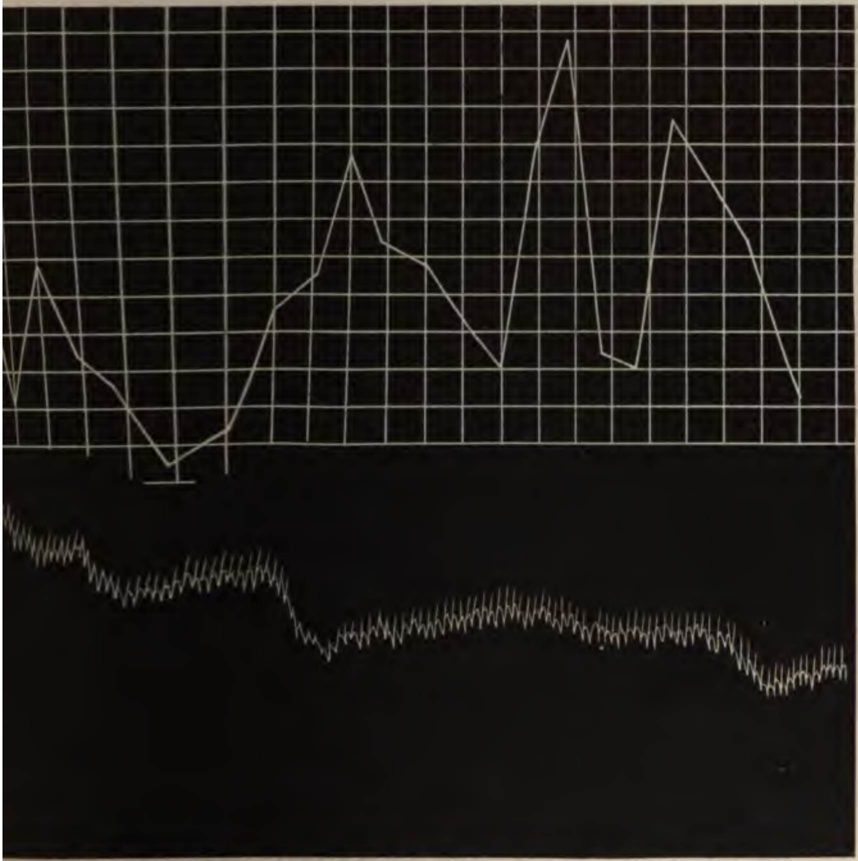

Fig. 5. Pl. subject. Interval 0.92″. Curve reads from left to right.

thysmogram are largest, that part of the estimation curve corresponding to it shows greatest variations. There is another point which this curve exhibits in common with those of the large intervals, that, as the intervals grow longer, the deviations of judgment from the normal interval grow larger.

There are only two vaso-motor waves in Fig. 6, p. 16, that can be said to correspond exactly to large deviations in the curve of judgments. Although, as was observed in the preceding curve, the fluctuations in estimation are largest with corresponding changes in the curve of blood volume.

As was said earlier in this article, the method of direct comparison does not yield as conclusive evidence as does the method of averages. And in either case, it must not be supposed that longer than this. The reason for that is that the plethysmograms showed hardly any vaso-motor waves. This was due, in all probability, to the unusually cold weather during which the last experiments were made, and also to the fact that the building was not heated. It is barely possible that their absence is due to the inhibitory effects of the longer intervals.

The difficulty that was experienced by most subjects with the longer intervals, and in particular, interval 5.45″ showed itself very plainly in the plotted curves. With the smaller intervals the amount of variation in either direction from normal the interval was comparatively small; but with longer intervals the uncertainty of judgment showed itself by the extremely large variations on both sides of the norm. In the last intervals this often amounted to two or three seconds.

The Constant Error. With reference to the constant error our own experiments as a whole divide themselves into two groups, all dependent upon the number of reproductions of the normal interval. In the first group [Intervals 0.18″-0.72″] there were, at first, five or six, and finally two reproductions made after each normal. But as this procedure proved detrimental by causing some of the subjects to hasten their judgments it was abandoned for the single reproduction method. In the second group [Intervals 0.40″-7.24″], therefore, but one reproduction was made for each presentation of the normal.

The effect of the number of reproductions upon the size of the constant error has received too little investigation, as yet, to speak with much certainty about it. As Nichols says, "New experiments seem needed for the tripartite relations between the sign of the Constant Error, the number or length of time the norm is given as a sample, and the number of reproduced judgments." Stevens [Mind, XI, p. 393], however, used the method of multiple reproduction, and has published the average judgment for each five seconds after the normal to the end of the series. The result is a very decided diminution of the size of judgment for each successive five seconds, as the series taken from Table II, p. 395, will show:

N=1.44 (1) .960 (2) .830 (3) .740 (4) .710 (5) .677 (6) .610 (7) .590 (8) .480 (9) .360. This result is common to all of the tables as published. Nichols also used the multiple reproduction method, but has published only the first judgments after e normal. He says, however, that for one subject, L, the gments are "unusually short throughout the experiments, in the curves, show themselves growing rapidly shorter horter to the end of the drum," while the "judgments of unusually long throughout all his trials, and his curves ly up throughout each drum." In our own experiith the multiple reproduction there were, also, opposite tendencies to be observed in different subjects. Thus Br. and Bt. showed a constant decrease with each reproduction, which very probably accounts for the small indifference time of Br. [0.46″] and the irregularities in Bt's constant error [Table IV]. While, on the other hand, the remaining subjects showed a constant enlargement of each successive judgment. Although the number of reproductions was, probably, too small to say finally what the effect would be.

From our own experiments the effect of the single reproduction may be inferred with more certainty. With but two exceptions all subjects show a positive error at 0.46″. One of the exceptions, Bt., gives a positive error at 0.58″. These intervals were estimated by multiple reproductions. On the other hand, all subjects but Py. [c=+.018] show a marked underestimation of the first interval [0.40″] in the second group. We may conclude, therefore, that the effect of the single reproduction is a decided lowering of the first indifference point.

The results of each reagent are given in a separate table. There are six columns given in each table. (1) The number of the interval in order of size. (2) The normal interval in hundredths of a second. (3) The constant error in hundredths of a second with the positive or negative sign prefixed to indicate an over or underestimation, respectively. (4) The average crude error. (5) The pure variable error. (6) The number of experiments made on each interval.

TABLE I. Py.

No.	N.	c.	Δm	$\frac{\Delta m}{N}$	n.
1	0.18	+.023	1.860	.1035	506
2	0.34	—.040	2.815	.2843	400
3	0.46	+.026	4.091	.0889	333
4	0.58	+.100	4.565	.07871	119
5	0.66	+.060	7.0671	.10705	117
6	0.72	+.027	4.509	.06262	173

No.	N.	c.	Δm	$\frac{\Delta m}{N}$	n.
1	0.40	+.018	3.488	.08708	261
2	0.70	—.028	4.441	.06605	241
3	0.92	—.017	7.516	.0816	172
4	1.32	+.18	14.434	.1099	139
5	2.40	+.235	31.1292	.1296	61
6	3.70	+.65	53.261	.14391	65
7	5.45	+.573	64.302	.11673	40
8	7.24	+.443	93.267	.12882	32

The constant error, as shown by Py's results, is, in general, a typical instance of its course as exhibited in our experiments.

Yet there are some peculiarities that are not common to the other subjects. One striking exception is the negative constant error at 0.34″ in the first group. The reason for this, probably, lies in the fact that interval 0.34″ was the first one used in the beginning of the investigation. Hence, the lack of practice may account for it. Nichols also points out that any "slight nervousness or excitement of the subject shortens the judgment." This, too, may have had something to do with it. The change of sign of the constant error at interval 1.32″ in the second group is also somewhat anomalous. But as the overestimation after this is constant the cause will have to be ascribed to some individual peculiarity.

TABLE II. Br.

No.	N.	c.	Δm	$\frac{\Delta m}{N}$	n.
1	0.18	+ .004	1.5803	.08834	371
2	0.34	+ .025	1.987	.05840	422
3	0.46	— .045	2.730	.05932	509
4	0.58	— .011	3.524	.05990	129
5	0.66	— .049	4.2306	.06409	109
6	0.72	—1.02	3.893	.05406	132

No.	N.	c.	Δm	$\frac{\Delta m}{N}$	n.
1	0.40	—.035	4.079	.1019	244
2	0.70	—.068	4.792	.06827	227
3	0.92	—.073	4.823	.05237	183
4	1.32	—.013	12.093	.0916	139
5	2.40	—.117	17.350	.07229	40
6	3.70	+.02	47.999	.12973	44
7	5.45	+.160	254.570	.46706	35
8	7.24	—.30	63.030	.08705	34

The small indifference time of Br. [0.46″] in the first group is probably due, as I have already said, to the constant tendency to decrease the size of each successive reproduction. Yet it may be wholly normal as the indifference time as given by Külpe varies between 0.5″ and 3.0″. The sign of the constant error in the second group changes somewhere between 2.4 secs. and 3.70″. It also, again, changes signs at 7.24 secs. What this last change is due to I am at loss to know.

The points to be noted in the course of the constant error in Table III, p. 21, are the negative sign of the error at 0.72″ in the first group and the small underestimation of the first interval in the second group. There is also another indifference point tween 2.4″ and 3.70″. From there on the overestimation very large.

TABLE III. Ss.

No.	N.	c.	Δm	$\frac{\Delta m}{N}$	n.
1	0.18	+ .039	1.622	.09011	371
2	0.34	+ .027	1.769	.0502	126
3	0.46	+ .011	3.312	.07199	184
4	0.58	+ .017	5.1965	.08959	98
5	0.66	+ .232	12.55	.18999	129
6	0.72	—1.01	6.660	.09249	134

No.	N.	c.	Δm	$\frac{\Delta m}{N}$	n.
1	0.40	— .002	3.431	.08617	114
2	0.70	— .087	5.086	.07265	269
3	0.92	— .042	4.375	.0475	172
4	1.32	— .152	8.3852	.06396	91
5	2.40	— .267	18.942	.0812	32
6	3.70	+ .886	68.536	.18532	60
7	5.45	+1.5	131.08	.23984	36
8	7.24	+1.02	111.906	.15456	33

TABLE IV. Bt.

No.	N.	c,	Δm	$\frac{\Delta m}{N}$	n.
1	0.18	+.008	1.2022	.06678	536
2	0.34	+.040	2.180	.06411	22
3	0.46	—.038	3.100	.0674	254
4	0.58	+.015	3.6285	.06255	123
5	0.66	—.053	3.1134	.0471	132
6	0.72	—.066	4.1562	.05272	110

No.	N.	c.	Δm	$\frac{\Delta m}{N}$	n.
1	0.40	— .011	6.009	.1502	237
2	0.70	— .046	3.959	.0597	211
3	0.92	— .060	4.4365	.04822	177
4	2.40	— .080	17.452	.0745	73
5	3.70	+ .020	47.13	.1135	45
6	5.45	+1.23	85.554	.14461	45
7	7.24	+ .43	108.378	.14969	31

The constant error as derived from Bt's results shows considerable variation in the first group; the first change of sign at 0.46" and also the large negative error at 0.66" are in all probability due to the multiple reproduction. Yet the positive error at the interval [0.58"] between these two seems to contradict this, as it was obtained by the same method. The constant error in the second group agrees completely with the results of the other reagents, showing the underestimation from

0.40″ up to 2.40″ and an overestimation from 3.70″ on to 7.24″.

TABLE V. Pl.

No.	N.	c.	Δm	$\frac{\Delta m}{N}$	n.
1	0.18	+ .021	1.3355	.07419	346
2	0.34	+ .055	2.0537	.06035	186
3	0.46	+ .034	2.7260	.05925	199
4	0.58	+ .065	3.595	.06197	121
5	0.66	+ .037	3.7449	.05381	134
6	0.72	+2.03	8.0132	.10828	79

No.	N.	c.	Δm	$\frac{\Delta m}{N}$	n.
1	0.40	—.022	2.620	.0655	247
2	0.70	—.1005	6.506	.09291	230
3	1.32	—.200	12.546	.09650	64
4	2.40	—.255	24.329	.10136	70
5	3.70	+.59	54.539	.1475	43
6	5.45	+.48	46.075	.08453	42
7	7.24	+.60	46.969	.06483	24

The constant error in Pl's results in the first group show very decided overestimation in every case, and particularly at 0.72″. This is probably due to the fact that Pl. was one of the subjects who showed successively larger reproductions after the normal. The second group agrees in general with all of the others, showing an underestimation of the interval up to 3.70″, and from there on a very decided overestimation.

TABLE VI. Sr.

No.	N.	c.	Δm	$\frac{\Delta m}{N}$	n.
1	0.18	+.053	1.599	.08832	274
2	0.46	+.063	3.7806	.08218	176
3	0.58	+.078	4.7255	.08147	126
4	0.66	+.117	4.9906	.06861	125
5	0.72	+.055	6.1345	.08289	126

No.	N.	c.	Δm	$\frac{\Delta m}{N}$	n.
1	0.40	—.0325	4.043	.1009	246
2	0.70	—.204	6.629	.09445	233
3	2.40	—.19	18.038	.07515	100
4	5.45	—.17	50.034	.09273	43
5	7.24	+.40	58.453	.08073	33
6	....	......	......	......	...
7	....	......	......	......	...

Sr. like Pl. was one of the reagents who gave successively larger reproductions, and the large overestimation of all of the intervals in the first group is very probably due to that fact. In the second group the change of sign of the constant error does not occur until 7.24″. This may have its origin in the lack of reacting to some of the longer intervals, as no results were obtained from him on intervals 0.92″, 1.32″ and 3.70″. So that a considerably longer time elapsed between his experiment days and those of the other subjects.

The general course of the constant error shows an overestimation [in the first group] of intervals up to 0.72 seconds. Then an underestimation [in the second group] from 0.4″ to 2.4″, from which interval on the sign of the constant error is reversed, with an increasingly large overestimation. These results agree very closely with those obtained by Mehner [Phil. Stud. XI, p. 546] by the method of Average Error. The following table gives the normal intervals and the corresponding constant errors as obtained by him. p. 594.

N.	C.
0.70	+.09
0.80	—.025
1.00	—.068
1.50	—.1117
2.10	—.035
3.50	+.01
5.00	+.0375
6.00	+.94

With the exception of a disparity between the sign of the constant error for 0.70″ the two results agree very harmoniously. Mehner's second indifference point lies between 2.10″ and 3.50″, and our own between 2.40″ and 3.7″. Just at what point the sign changes would be impossible to conclude from either set of experiments. But, taken together, they would show that it lies between 2.4″ and 3.5″.

Weber's Law. The validity of Weber's Law for the estimation of intervals of time is still a moot point. There is, perhaps, an equal division of opinion among the many investigators who have discussed this problem. The results of Glass [Phil. Stud., IV, p. 453] as given in Table III show a greater constancy of the fraction of Weber's Law than any that I have seen. Of the results obtained from thirty-four intervals, in twenty-nine cases the first two figures are four hundredths, and in the remaining five cases five hundredths. From these results Glass concludes that Weber's law in the Province of Time Sense is to be considered an Ideal Law as Mariotte's Law is in Physics.

From our own results it would be very difficult to conclude in favor of the law. For, not only are there many irregularities, but also there seems to be an increase in the value of $\frac{\Delta m}{N}$ as the larger intervals are reached. Manifestly, if such is the case, one could not maintain that the law held. There is, however, a peculiarity that should be pointed out. Namely, that each subject seems to have an individual value of $\frac{\Delta m}{N}$ from which variation arise in either direction. In the case of Br. it is in the neighborhood of .0500 or .0600, while with Sr. it is most nearly constant at .0800. And it is in Sr's results, in general, that there seems to be an approximate constancy of the value of the average pure error.

Respiration as an Aid to Estimation. According to Münsterberg's theory of time estimation, the strain of muscles during respiration is made the basis of time estimation. We have endeavored to ascertain by the introspection of reagents just what part, if any, the strain of respiration does play. A pneumograph tracing was taken in the experiments from interval 2.40″ to 7.24″. The tambour was adjusted to write just over the series of normal intervals as obtained on the kymograph. So that by projecting the normal interval upon the respiration curve the phase of breathing in which the subject was when the limiting stimuli were given could easily be determined. And, likewise, the phase of breathing in which the judgment was made could be determined.

It may be stated generally from the introspection of the reagents that there was considerable tendency, and, in many cases, actual use of the respiration as a measure of the longer intervals. Thus, Br., Interval 3.70,″ says he "found himself estimating the interval by respiration, and could not keep his attention off from it." He expired on receiving each of the limiting impressions. Also with the interval next higher, 5.45,″ Br. reports that he intended to make his estimate by breathing. With the last interval, 7.24″, the same subject noticed a similar effect. He tried hard to keep attention off his breathing, but could not avoid reacting at expiration. Bt. reports that for interval 5.45″ he estimated entirely by respiration. But for interval 3.70″ and 7.24″ he did not use it, although in both of these intervals he used other means. With intervals 3.70″ and 7.24″ Py. reported the presence of strain sensations. With the shorter interval he noticed a tendency to estimate in terms of strain of respiration. With interval 5.45″ he observed that he "could not estimate definitely in strain sensation; but tended to do so," he "noticed that his judgment fell in the same phase of respiration as the normals." For interval 3.70″ Pl. reported that "during the first series all attention was given to estimating the interval by relating it to breathing. There was a very good relation between the normal interval and a certain number of inspirations and expirations (" two inspirations and one expiration equal to the normal interval). Then the estimate of the interval was made from this relation." Pl. was the only reagent who had any tendency to estimate the interval by counting. In one case, interval 3.70", he filled the interval with a rhythmical repetition of " one " " two " " instead of a consecutive count during the whole interval." Again, with interval 7.24", he says that " the judgments were made by counting consecutively up to nineteen or twenty." Sr., interval 5.45", is peculiar in being the only subject to report the presence of the strain of abdominal muscles in consciousness. He says that the strain sensations were most conspicuous at the end of the normal interval and at the moment of his reaction.

By projecting the point, indicated on the clock-work kymograph by the first click of the normal interval, upon the respiratory curve, the relation between the two could be plainly brought out. And almost universally for any given series, the relation between the two remained constant throughout. That is, for example, if the first click of the normal interval enters at the crest of the respiration curve, between the expiration and inspiration, the first click of the next normal interval will enter at precisely the same point with perhaps five or six complete phases intervening. If the point of entrance is shifted then there is a corresponding shift of the point of entrance of the next normal. These relations held generally for all subjects during the intervals in which the pneumograph was used.

The point in the respiratory curve at which the judgment was made, has been determined for three subjects only, in one interval [3.7"]. Time would not allow longer investigation. As has been said, the normal interval was obtained upon the kymograph, in addition to the tracing upon the revolving drum, and of course the time of the interval was known. Hence, to obtain the time of rotation of the kymograph, the distance in millimeters, between two normal clicks was divided into the lengths of the interval, which gave the length of time per millimeter. Then, dividing the judgment in time, by this quotient, gave the length of judgment in millimeters which could easily be measured from the second click of the normal interval and the point in which the judgment was made, accurately determined. This point, projected upon the respiratory curve gave the phase of breathing in which the judgment was made.

This point, as determined in the three cases alluded to, shows an approximate constancy for any given series. For example, in Pl's case, the judgment is made in two series at the trough of the respiration curve, between the phases of inspiration and expiration. This holds, generally, throughout; but if the point is changed it remains constant for the remainder of the series. Likewise, with Py. and Br. The judgment in Py's case falls at the crest of the respiratory curve between the phases of expiration and inspiration. But, in general, it remains constant throughout any one series. Br's judgment is made at the beginning of the inspiratory phase. And like the others, it is generally constant.

It cannot be concluded from these three cases that the relations observed here hold good for other subjects or for other intervals.

SUMMARY OF RESULTS.

1. The vaso-motor wave coincides, in at least 50% of the cases, with the fluctuation in the judgment of an interval of time.

2. For intervals above 3.7 secs. the strain of respiration may be used as an aid to estimation.

3. The method of single reproduction tends to lower the indifference point.

4. Intervals below 0.72″ [0.40″] are overestimated. From that interval to 2.4 secs, the intervals are underestimated. From 3.7″ to 7.24 secs. the intervals are overestimated.

5. Weber's Law does not hold for the estimation of time intervals.

6. There is no special Time Sense in consciousness; but our judgment of time is mediate, depending upon organic processes, of which the changes in blood volume is one of the more important.

CONCLUSIONS.

It has been stated in the summary that the vaso-motor wave in, at least, 50% of the cases, coincides with the fluctuations in judgment of a time interval. While this is not a predominating per cent. of all cases, still it may be taken as a positive answer to the problem as stated at the outset. It should be remarked here that the best coincidences and, in fact, all of those exhibited in this paper, occurred on intervals of time from 0.4″ to 2 seconds in length. This is borne out by many of the curves not published. This would seem to indicate some sort of connection between the indifference time or "unit of time" and the vaso-motor waves. But just what the relation is can not be determined from these experiments. The general length of the vaso-motor wave, as shown in our results, varied from five to twenty seconds. The general length of the fluctuation in judgment likewise varied from six to thirty-five seconds. On the whole there seemed to be a gradual increase in the length of both vaso-motor wave and fluctuation of judgment as the length of the interval was increased. But, in any case, the two kinds of variations stay fairly well together.

In attempting to determine the part played by the vaso-motor wave and respiration, in the estimation of intervals, there seems to be an obvious line of distinction between the two processes. As has been said, the best and most frequent coincidences of vaso-motor curve and curve of judgments occurred at intervals of 0.4″ to 2.0″ in length. On the other hand, it was not until interval 3.7″ had been reached that subjects began to report any tendency to use respiration as a measure of the interval. Bearing these two facts in mind, it would seem that each function plays a more influential part according to the length of the interval estimated. For intervals of medium length [0.4″—2.0″] it would appear that the vaso-motor changes, of all factors, predominated. While for longer intervals [3.7″—7.24″] the respiration is, apparently, of greater influence. Yet it must not be inferred from this that the vaso-motor changes and respiration are the only factors involved in the estimation of intervals. We can only say that they were most conspicuous in our experiments. As to muscle strains alone, apart from respiration our experiments offer but little evidence. In fact they were reported by but one subject, and that for only one interval. So that their function, if any they have, must remain undecided by these experiments.[1]

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[1] I wish, here, to thank the gentlemen who kindly gave their time to serve as subjects in this investigation. Particularly, Mr. J. H. Bair, who acted as assistant. It was due to his careful work that the plethysmograph yielded the good results that it did.

A CONTRIBUTION TO THE PSYCHOLOGY OF RHYTHM.

By CHARLES H. SEARS, Fellow in Psychology, Clark University.

The paper here presented is a report of an experimental study of the time values given by competent players to the notes of several simple selections of music. When the musician begins his studies certain statements are made to him with regard to the relative values of notes. He is told that a half note should be given half the time of a whole note, a quarter note half the time of a half note, an eighth note half as much time as a quarter, and so on, and that a dot placed after a note adds one-half to its length. It is implied that all notes of the same kind should receive equal amounts of time unless a change of tempo is indicated, that a triplet should divide into three equal parts the time usually given to two like notes, that, except for purposes of expression, all measures are of the same length, etc. Toward fulfilling these requirements he strives with the metronome as an assistant. How far the trained musician accomplishes what the notes set before him indicate and what he sets out to do is an interesting question not only to the psychologist, but also to the musician. To answer this question for a few simple cases by direct measurement of the lengths of the notes played has been the aim of this study. The problem was suggested by Meumann, but so far as I know, no investigator has offered a contribution of facts gathered directly from the records of performers, although some work has been done in closely related fields as will presently be shown.

The work was undertaken at the suggestion of Dr. E. C. Sanford, to whom the writer most cordially acknowledges his obligation for help rendered throughout its progress.

RÉSUMÉ OF LITERATURE.

Because of the publication of Meumann's able working over of the whole subject of rhythm[1] it is natural to begin with him. We shall of course confine ourselves here to his discussion of rhythm in music, which he considers from the standpoints of the hearer, the player, and the composer.

In musical rhythm there appear not only the elements that are found in rhythmizing of uniform sounds and other simple rhythmical material, but also a number of new elements due to the special rhythmical material or rhythmizomenon in question. Working upon these the universal pleasure in tones and their combinations has brought about the peculiarly rich artistic development of musical rhythms. In a corresponding way the intellectual factors on which depend the perception of melody and harmony and the comparison of the different parts of musical compositions, as well as the play of association, memory, and fancy, are all more complicated and intense than with simple sounds. The same is true, of course, of the feelings and emotions excited. It is of interest to note, however, that in the perception of a rhythmical series of simple sounds the rhythm holds the first place, while in music it yields at least a co-ordinate place to the other distinctively musical factors.

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[1] Untersuchungen zur Psychologie und Æsthetik des Rhythmus, *Philosophische Studien*, Bd. X, S. 300.

But quite aside from this, the tones themselves do not behave like simple sounds. A low tone, for example, appears less intense than a high tone of the same objective intensity; the sudden breaking off of a quickly played tone series gives to the last tone a sort of accent, to be explained on the ground of sound summation. Tones are also possessed of real quantity, *i. e.*, they can be continued for a longer or shorter time, a thing that is not possible with simple noises; and with this belong also all the rhythmical effects arising from legato and staccato playing.

In treating rhythm from the standpoint of the player Meumann discusses the question of how the musician is able to produce the exact fractions of time intervals required by the notes on the written sheet. Experiments made upon subjects skilled in piano playing to determine how accurately intervals equal to certain fractional parts of given intervals could be produced when there were no artificial means of assistance showed that even good musicians were liable to considerable errors. A second test was made in relation to the observance of tempo. In this a good piano player was required to beat a rhythm first in accompaniment to a given standard rhythm and then alone. The intervals between the single strokes of the beating were 0.4 and 0.3 seconds. After the observer had beaten the rhythm thirty to forty times the standard rhythm was discontinued, while the subject kept on. As soon as the standard rhythm ceased the beating of the subject began to change. The tempo was first retarded, then the relative times of the intervals were altered, and gradually a change followed in the rhythm itself. These tests make it probable that the musician must have at his command in his ordinary playing some means or other of assistance. This means of assistance Meumann finds in a certain motor appreciation of duration; and the high degree of accuracy with which a musician can produce a required fraction of a standard interval when it is part of a musical score must be ascribed largely to this motor appreciation, *i. e.*, to the facility with which a rhythmic movement becomes automatic. In playing with both hands another means of control is possibly furnished by the aid one hand may give to the other. For example, when the right hand plays a complicated passage, the left supported by its automatism can preserve the original rhythm, marking for the right hand the essential points of each measure. Counting introduces still another motor procedure, which becoming quickly automatic acts as a steadying influence. The movements of the director have a similar result. The effect of all this automatism is to unburden the attention so that it may concentrate itself upon the musical purport of the tones.

To Binet and Courtier[1] belongs the credit of having recorded by the graphic method the fingering of pianists with indications of the force and time relations of the strokes and of suggesting a number of problems that can be solved in this way. Their results may be summarized in part as follows: The fingers of pianists are unequal in strength and lack independence. This follows naturally from the anatomical structure of the hand. In the execution of trills played with the index and middle fingers the irregularity of the movements, as shown by tracings, is marked. However, a high degree of regularity results from practice. In playing the piano notes are frequently slurred or tied. These effects may arise from a variety of conditions, three of which are: "1. In the movements of the last fingers, especially of the third and fourth. 2. In the state of fatigue; the slurring or tying of notes is a rest for the sluggish or fatigued hand. 3. In movements of great rapidity." The movements of the thumb vary in facility of execution; those coming after the third and fourth fingers are more difficult to perform than those that follow the first and second. The notes preceding the thumb movements have a diminished intensity. In slow playing the notes are rarely tied or slurred, and both the notes and intervals are regular. But as the rate of movement increases the irregularities become more and more apparent. A renowned musician in playing five successive notes was found to retard the interval between any two notes 0.01 of a second. In ten successive trials it was observed that the value of the intervals always increased as they advanced up the scale, the average increase varying from 0.01 to 0.015

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[1] Recherches Graphiques sur la Musique, L'Année Psychologique, 1895, p. 201.

of a second. In relation to the accentuation of single notes these investigators found that a tendency exists—"1. to separate the accented note from the preceding note, 2. to tie or slur the accented note to the following note, 3. to increase the length of the note accented as if this increase were equivalent to an increase in intensity, 4. to increase, especially in rapid playing, the intensity of the notes which follow the note accented."

Ebhardt has made two contributions to the psychology of rhythm and tempo[1]—one on the influence of accent on the relations in musical rhythm and the other on the influence of accompaniment on the tempo. In order to discover the effect of rhythmic accent on temporal relations he first conducted a course of free tapping experiments consisting of both accented and unaccented series of sounds. He found that absence of accent was attended by a want of uniformity in the time relations of the members, but that there was no constant increase or decrease of the times in the course of the series. His results show that the greatest uniformity of movement lies approximately within that range of rates within which Vierodt[2] found the greatest exactness of judgments, that of 0.4-0.7 seconds. In the case of series with accent, experiments were made upon the different forms of bipartite and of tripartite rhythms. In all of these forms the variations of the members from one another appeared far greater than in the unaccented series, *i. e.*, the errors were the largest in the accented series. The conclusions drawn from these experiments are that a rhythmic accent exerts a disturbing influence on the keeping of time, that it is a source of constant error, and that in the great majority of cases the accent gives rise to a lengthening of the time of the accented member. There is much evidence for the opinion that accent causes not a shortening of the preceding but a lengthening of the subsequent member. In two forms of the tripartite rhythm—the one in which the second member and the one in which the last member receives the accent—when the repetitions were somewhat lengthy, the accented member showed a tendency to change gradually its order in the group. In the production of tripartite rhythms the groups were separated into unities by means of an inserted pause. This was the most easily done and the most distinctly marked in rapid tapping. As the movements became slower this separation of the groups gradually faded out.

The investigations on free tapping were followed by experiments in which simple tone series were played on the piano. The use of the piano brought in certain changes, such as the appearance of tones in the place of noises, the use of not only one but of all the fingers, etc. The series of experiments corresponded exactly to that used in the investigations on free tapping. With the exception that the variations were somewhat smaller the results in all cases showed the same general characteristics as in the previous tests. Neither in the tapping nor in the playing of simple rhythms did the variations all lie in the same direction—some were positive and some were negative.

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[1] Zwei Beiträge zur Psychologie des Rhythmus und des Tempo, *Zeitschrift für Psychologie und Physiologie der Sinnesorgane*, Bd. XVIII, p. 99.

[2] Untersuchungen über den Zeitsinn, Tübingen, 1868.

The experiments made for the purpose of finding out the effect of an accompaniment on the tempo consisted in having a certain portion of a piece of music played with and without accompaniment, and in every case taking the playing-time with a fifth of a second watch. In playing a passage repeatedly it was found that the variation in the amount of time required for the different performances rarely exceeded 0.2 to 0.3 seconds on an average. In playing 19 selections, nine of which were given 20 trials each, seven, 16 trials, and three, 10 trials, less time was required for the performing of each selection when played with accompaniment than when played without acccompaniment. Ebhardt explains this result on the ground that feeling enters in as the determining factor of tempo; an accompaniment increases the emotional effect. A number of the selections were also played upon a dumb clavier. In every case more time was taken than had been required for playing the same pieces without accompaniment. This retardation is attributed to two causes,— an increase of psychical activity, which consumes an excessive amount of time, and to a retardation in the rise of the feelings which do not come forth so quickly as with the full tonal sensations. The retardation is not noticed for the reason that consciousness has no means of perceiving absolute rate.

In a carefully conducted set of experiments Shaw and Wrinch[1] sought to determine by means of tapping movements "the degree of accuracy that obtains in the reproduction of complex rhythmically arranged groups of intervals of unequal length." From their results it appears that the average mean variation, when expressed as a percentage for all the reproduced groups, was only a fraction of one per cent. greater than it was for a series of simple intervals, and that the average ean variation of the complete groups was quite uniform, and ller than it was for the individual intervals of the more plicated groups. In the repeated reproductions of a series the different lengths of the intervals held to one another within certain limits a comparatively uniform relation—there seeming to be a tendency to increase rather than lessen the accuracy of their reproduction as the number of judgments became larger. The length of the intervals was not affected by the differences in the pitch of the tones forming the melody.

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[1] versity of Toronto Studies, Psychological Series, 1899, p. 44 ff.

In the records of ten intervals from the "Boccaccio March" there appeared four distinct types of notes, but their lengths did not hold to one another "the definite relation of one, a half, a fourth, and an eighth, as in written musical compositions." This leads the investigators to affirm that while their experiments yield nothing conclusive upon the subject yet they do indicate that "the relative length of musical notes in the production of a true musician is not in the exact ratio of one to a half, a quarter, an eighth, and so on."

General Summary of Literature. While the investigations cited have not been reports of the time values given by practiced musicians to the notes of complete musical compositions, yet they have relation to intervals and groups of intervals occurring in musical rhythms. A brief summary of the results that are important in connection with the present investigation may be made in the following statements: Musical rhythms contain elements additional to those found in simple rhythms and are therefore more complex. In music rhythm does not hold the primary place, but a co-ordinate place with other distinctively musical factors. Irregularity of movements in playing results from peculiarities due largely to the structure of the hand. Much of this irregularity may be overcome by practice. Irregularity is the most marked in rapid playing which leads to the expectation that in the production of a piece of music those measures that contain many notes will possess greater variations than those containing only two or three. Pitch of tones has no effect on the relative length of intervals. For simple intervals without accent the greatest exactness of execution is between 0.4-0.7 seconds. Accent, increasing the irregularity of the time relations in the group, is the source of a constant error. Usually the accented member is lengthened. In the production of complicated groups of intervals of unequal length the judgments are somewhat less uniform than for simple intervals, the individual intervals of the groups showing a greater variation than the complete groups. The time relations for the different reproductions of repeated groups of intervals show a tendency to remain quite constant. When a selection is played repeatedly there is little variation in the total time required (Ebhardt). The degree of accuracy which a musician secures in the production of intervals in the relation of one, a half, a quarter, and so on, is to be attributed to the facility with which rhythmic movements become automatic (Meumann). An accompaniment influences the tempo by decreasing the total time. In the rendering of a piece of music musicians probably do not produce the tones in the exact ratio denoted by the written notes (Shaw and Wrinch).

PRELIMINARY EXPERIMENTS.

The Time Intervals in Selections Played by a Music Box. The purpose of this preliminary investigation was to discover the nature and extent of the variations in the duration of the tones in music produced in this very mechanical way. The music box used was of Swiss make, of medium size, and played ten pieces. The method employed was to count the number of half turns made by the fan regulator between the sounding of the individual tones when the mechanism was made to move very slowly. To facilitate this labor a mechanical counter was used which recorded each half turn of the regulator as it was allowed to take place. The number of half turns in the duration of the tones in the pieces studied were counted in this way three times. The counts for the same note sometimes varied one or two half turns in the different counts, but generally not at all.

Two pieces were thus measured, "The Blue Alsatian Mountains" and "La Gitana Waltz." Both are written in ¾ time. The music box in each case played only the principal theme to which, however, certain notes not found in the piano score were added. In reckoning up the results these variations of score have not been considered. The results are given below in half turns of the fan regulator, a half turn being equal approximately to 0.0074 of a second.

The part of "The Blue Alsatian Mountains" played by the music box contained 27 measures. The average length of the measure was 89.30 with M. V. of 2.28. The greatest difference between any two consecutive measures was 10. The average irregularity[1] was 2.73. In the part of "La Gitana Waltz" played there were 16 measures. Their average length was 8.13 with M. V. of 2.27. The greatest difference between any o consecutive measures was 9. The average irregularity was

e variation in the notes of the same kind is also well ed. The average length of the notes of the different denominations is as follows: In "The Blue Alsatian Mountains:" quarter note, 30.73 with M. V. of 1.83; half note, 58.42 with M. V. of 1.42; dotted half note, 86.83 with M. V. of 1.83. In this piece there was no more than one note of any of the other denominations. "La Gitana Waltz:" quarter note, 25.67 with M. V. of 1.44; eighth note, 14.25 with M. V. of 2.25; dotted quarter note, 34.25 with M. V. of 1.12; half note, 54.0 with M. V. of 2.0; dotted half note, 78.20 with M. V. of 2.64. It is interesting to observe that in "The Blue Alsatian Mountains" the notes of the denominations other than a quarter note are shorter than their proportionate value as measured by the quarter note, and that with the exception of the dotted quarter the reverse appears true in "La Gitana Waltz." Whether this is purely accidental or the result of design cannot at present be determined.

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[1] "average irregularity" is found by averaging the differences *the successive measures*, and gives a result somewhat larger mean variation, found in the usual way by averaging the s of the individual measures *from their mean*. The "average ity" has been used here and below, because it is believed to r index of the particular sort of irregularity in question.

As regards the relative length of accented and unaccented notes nothing certain appears. Comparing the average accented note with the average unaccented note there is found in both pieces a very slight difference in favor of the unaccented note, but the probable error in both cases is so large that the difference has no significance.

The data which this study of the music box presents toward the solution of our main problem is not very great; but, since its selections may be supposed to be rendered in reasonably good time, it does give some indication of the extent of variation in the length of measures and notes that will ordinarily pass unobserved, and furnishes, as a very "mechanical" means of producing music, an interesting basis of comparison with the performers whose playing is next to be considered.

TIME RELATIONS IN THE PLAYING OF MUSICIANS.

Apparatus, Method, and Subjects. The instrument used was a small reed organ manufactured by Messrs. Moore and Moore, of London, and tuned according to the directions of Ellis for use as a Harmonical.[1] For rhythm experiments the organ has one important point of difference from the piano. Upon it the intensity of the tone does not vary with the intensity of the finger stroke.

It was necessary that the recording portion of the apparatus should meet the following conditions: 1. It should be free from all disturbing noises; 2. It must not modify the action of the instrument so as to interfere with the technic of the playing; 3. It should register accurately and return to its original position the instant the sound of the tone has ceased. Electrical registration by means of mercury contacts was employed, the records being finally traced upon the smoked surface of a kymograph drum. The contacts were arranged as follows: Steel pins were passed through the keys about two and a half inches from their back ends. Beneath the keys at the back of the instrument was placed a series of mercury cups in such a way that when a key was depressed the lower end of its steel pin would dip into the mercury and make an electrical contact. To the upper end of the pins were attached wires which led to brass buttons fastened to the back of the organ frame. From these buttons other wires led to four writing magnets, three Deprez and one Pfeil signal, which wrote on the smoked drum. It is obvious that with so small a number of writing magnets it would be impossible to record all the notes of all the parts in a harmonized piece of music. It was therefore decided to record only the upper or soprano part, that being the leading part and the one most likely to show the general time relations which were the chief matter of investigation. In order to secure even this with so few inscribing points it was necessary to arrange the wiring so that no two consecutive notes should fall to the same point. This was worked out for each selection by previous study, and wire connections were especially arranged each time for each selection by attaching or detaching from the brass buttons above mentioned. As the apparatus was finally arranged three notes could be assigned to each magnet, though as a general thing this was not required. An example will make the matter clearer. In one of the pieces used there are ten different tones in the soprano part, viz., *d′*, *e′*♭, *f′*, *g′*, *a′*♭, *a′*, *b′*♭, *c″*, *d″*, *e″*♭. The keys corresponding to these tones were distributed to the four writing points as follows: To point 1. *e′*♭, *a′*, *e″*♭; to point 2. *d′*, *g′*, *d″*; to point 3. *b′*♭, *f′*; to point 4. *a′*♭, *c″*. By reference to the selection (No. 254, below) it will readily be observed that in its execution the keys connected with the same point were never depressed consecutively. Thus there was between any two functionings of a single point one or more records made by one or more of the others. By this means each note had a distinct place in the record, and thus the reading of the record was facilitated.

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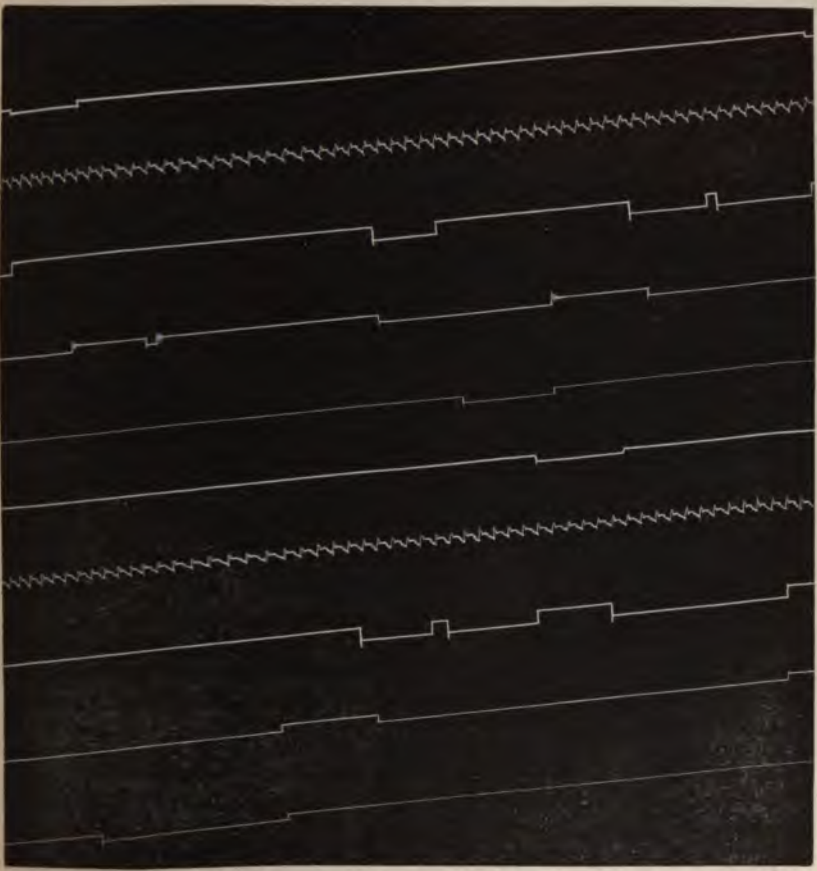
[1] *Cf.* Ellis's translation of Hemholtz's Sensations of Tone, Second Edition, p. 466.

In reading the kymograms the notes on the different lines were read in the order in which they occurred in the selection played. For example, in the specimen record here reproduced the transitions from one line to another were made as follows: 1 to 2, 2 to 3 (two notes), 3 to 4, 4 to 3, 3 to 2, etc.

In addition to the four points already mentioned a fifth wrote simultaneously a time-line in tenths of a second from which values in hundredths could be read by estimation.

Before each subject began playing such adjustments were



carefully made as should make it certain that the recording of each note would begin at the instant the key was sufficiently depressed to produce the first sound of the tone.

It was thought that the usual way of blowing the organ with the feet might act as a disturbing factor in that it would itself require a certain rhythmic movement or possibly a partial division of attention, either of which might interfere with the subject's rendition of the music to be played. To avoid such effects the organ was arranged for hand blowing by an attendant. This method obviated the difficulties mentioned, but proved not absolutely noiseless. The subjects, however, reported themselves as uninfluenced by this noise. Care was taken to work the bellows irregularly so as to prevent the sounds from furnishing any regular rhythmic effects.

Screens hid from the subject's view all the recording apparatus and as far as possible the movements of the attendant who worked the bellows.

The music selected for the investigation consisted of church hymns. Five selections were made, each of which contains some characteristic feature peculiar to itself. (See the scores in connection with the tables at the end of the article.) In most cases the subjects played the air only, and three records were taken successively of each hymn. In case of two of the hymns, all four parts were also played, the air alone being recorded. In these cases two records only were taken.

Before taking any records the subject had ample opportunity to familiarize himself with the action of the organ and the selections to be played. He was given perfect freedom to play in his own natural way. Records were taken from four different persons, all practiced musicians. B, M, and W were church organists. B and M were professional musicians of considerable local prominence, teachers and chorus directors. S, the wife of the writer, has been a music teacher and a church organist, but at the time of the experiment was somewhat "out of practice."

The first examination of the records disclosed the fact that very rarely did one tone begin at the instant that the preceding one had come to an end, but that one tone usually began before the preceding one had ceased. This occasioned what may be termed an "overlapping" of tones. Sometimes, however, an interval occurred between two successive tones instead of an overlap. In counting up the records it was therefore essential to report two things, namely, (1) the time during which the note sounded, and (2) the length of the overlap or interval by which it was connected with the preceding and succeeding notes. In the final reckoning up of the lengths of the notes it is necessary to take these overlaps and intervals into account, and this has been done throughout on the assumption
note was intended by the player to last until the fol-
ote was struck and no longer. The overlap has there-
subtracted from the full time of the preceding note
se in which it appeared and the interval added when
l.

TESTS IN WHICH THE AIR ALONE WAS PLAYED.

ate. The time occupied in playing the whole
tion is of course a slightly variable one. It not
different subjects in playing the same selection,
same subject in playing the same selection at
The results below give in seconds the average

time of the three trials for the different subjects and the different hymns.[1]

TABLE I.

Showing in seconds the general rate when the air alone was played.

	SUBJECTS.			
Hymn.	S	B	M	W
18	28.20	31.33	23.83	23.57
53	18.32	18.75	18.41	16.83
254	38.87	36.54	——	——
464	33.20	35.01	21.26	——
516	——	——	41.39	38.09

The greatest difference between any two subjects for hymn 18 is 7.76; for hymn 53, 1.92; for hymn 254, 2.33; for hymn 464, 13.75; and for hymn 516, 3.3. In a comparison of the average times of the different subjects for playing the different selections it appears that it is a general characteristic of W to play at a faster rate, and of B to play at a slower rate than either of the others. Beginning with the one having the least rapid rate the subjects stand in the following order: B, S, M, W. In hymn 464 no satisfactory explanation can be made for the great difference 13.75. M in all three trials played this special selection at an unusually rapid rate.

The greatest difference existing between any two consecutive trials by the same subject and with the same selection is as follows:

TABLE II.

Showing the greatest difference between any two successive trials.

	SUBJECTS.			
Hymn.	S	B	M	W
18	.17	2.16	1.35	.79
53	.38	2.21	2.73	.82
254	1.17	2.74	——	——
464	.54	1.87	1.03	——
516	——	——	1.27	.[71][2]

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[1] For hymns 254 and 516 records were taken from two subjects only. In the tracings for W., hymn 464, the relations of the writing points at starting could not be determined with sufficient exactness, and the records were rejected.

[2] One of W's records with hymn 516 could not be used in this case.

Subject S in the case of hymn 464 and subject M in the case of hymn 516 performed one of the trials on a different day from that on which the other two were played, with a difference in time of 2.78 for S and 3.14 for M.

On account of the size of the drum of the kymograph only one trial could be recorded at a time for most of the selections. Thus it was necessary before each repetition to pause long enough to substitute another drum or to apply and smoke a new paper. In the case of selection 53, however, it was possible to make two records on the same drum, and there was thus only a brief pause between each two of them, with a pause of the usual length between the twos. On comparison of the length of the three trials in the case of the other hymns it was found that the first trial was the shortest 7 times out of 9; the third trial was the longest 4 times out of 7; and the second trial took more time than the first trial, but less time than the third 7 times out of 10.[1]

In hymn 53, where two records were taken with practically no intervening pause, every subject required less time for the first trial than for the second. In the case of B a second set was counted in which the reverse appears true, but the combined time expressed by the two records in this set exceeded that of the first set by 4.88. These facts would indicate, so far as they have a general significance, that a musician in playing a selection a second time tends to play it at a slower rate than he did the first time, provided no pause or only a short one lies between the original performance and the repetition. This result is the opposite of that found by Triplett and Sanford[2] for the recitation of nursery rhymes.

The differences appearing in Tables I and II are of such a nature as to elude explanation except as "personal differences," though a fuller study of the individual subjects would probably account for some of them.

Bach and his school tried to establish an absolute standard of rate, taking as a typical measure a group of four quarter notes, one to every pulse beat. To this measure the time values of all others bore a constant ratio.[3] But such a system as this, f strictly carried out, would be as apt to increase as to decrease ch irregularities as are here under consideration; and modern sicians having set aside the normal pulse beat, find their

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here are not the same number of trials throughout for the reason one instance one subject gave the first and third trials the mount of time, and that in two other instances one of the was taken on a different day from that of the other two.

ican Journal of Psychology, Vol. XII, pp. 376, 382.

rath: Rhythm, Melody and Harmony, *Music*, XVII, 37 f.

absolute standard in the metronome or in the number of quarter notes per minute.

The Measures.

The measures vary not only with the general rate but among themselves for the same subject and the same selection. The following table gives the average time of the measures in the different selections. Here and throughout the remaining part of the work partial measures at the beginning and at the end of a selection are not taken into account; and the last full measure, owing to its being affected by the approaching close of the piece, is also excluded.

TABLE III.

Showing in seconds the average length of the measures.

	SUBJECTS.			
Hymn.	S	B	M	W
18	3.43	3.65[1]	2.94	2.81
53	3.08	3.16	3.07	2.66
254	2.39	2.23	——	——
464	2.07	2.18	1.34	——
516	——	——	1.75	1.59

Examining the measures as they appear in the individual trials the greatest difference between any two successive measures may be found. These differences are stated in the following table. The figures in smaller type below the differences represent the value of the differences as a percentage of the corresponding average measure in the preceding table.

From these amounts the differences of successive measures fall away to zero. In order to indicate the average amount of variation we may calculate the "average irregularity as explained above." The results are given in Table V.

There is no clearly evident order in the variation of the measures except a retardation when nearing the end of the

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[1] Average of six measures. In every trial B made a disproportionately long interval (pause) at the end of the first half of the selection. If this interval, which amounts to .36 sec. is added to the preceding note, as has been done in the case of all other intervals, the time of the full measure becomes 4.65 seconds. If this measure is taken into account the average length of a measure for B with this hymn becomes 3.80 instead of 3.65 seconds.

TABLE IV.

Showing in seconds the greatest difference between any two successive measures in the individual trials.

	SUBJECTS.			
Hymn.	S	B	M	W
18	.25 7.3	.29 7.9	.18 6.1	.18 6.4
53	.23 7.4	.31 9.8	.12 3.9	.27 10.2
254	.27 11.3	.17 7.6	——	——
464	.24 11.6	.25 11.5	.17 12.7	——
516	——	——	.23 13.1	.39 24.5

TABLE V.

Showing average irregularity.

	SUBJECTS.			
Hymn.	S	B	M	W
18	.096	.128	.072	.073
53	.066	.098	.082	.140
254	.095	.058	——	——
464	.099	.057	.053	——
516	——	——	.088	.174

selection. In the final averages the last full measure is longer than the next to the last 12 times out of 15; it is equal once and smaller twice. The next to the last is larger than the one preceding it 9 times, equal twice, and smaller 4 times out of 15. If the measures in the separate trials are examined then the last full measure is longer than the next to the last 35 times out of 47, equal 3 times and smaller 9 times; and the next to the last is larger than the one preceding it 29 times, equal 3 times and smaller 15 times.

The general irregularity seems to be greater in the last half of the selections, but this is due chiefly, if not entirely, to the terminal retardation already mentioned. As regards other possible relations the most that can be said is that in some of the hymns there is a suggestion of a systematic arrangement in the length of the measures within the groups allotted to the lines of the hymn or within the corresponding musical phrases.

This takes the form in two of the hymns roughly of a slowing from first to last within the line or phrase group and in a third of a progressive quickening. In the other two cases no such relation can be made out. One of the latter was played from a manuscript score, and the words were unknown to part of the subjects. The evidence furnished by the tracings for such an accommodation of the music to the words is too slight to warrant the assertion that it exists, but, nevertheless, such a relation is not impossible.

The Notes.

Since the time of the measures is variable, it follows that the time of their component parts must also vary. Such variations are found not only in the different measures, but even in the same measure. The variation of the notes of the same denomination in different portions of the same selection need not be discussed here. That they do differ and how widely may be seen in the tables at the end of the article, where the average time values are given together with the musical score. The table below gives the average length of the various kinds of notes irrespective of their place in the selection.

TABLE VI.

Showing in hundredths of a second the average length of notes.

HYMN.	SUBJECT.	WHOLE.	DOTTED HALF.	HALF.	DOTTED QUARTER	QUARTER	EIGHTH.
18	S			87		41	
	B			92		44	
	M			74		37	
	W			71		35	
53	S			111	80	51	22
	B			109	79	53	23
	M			101	76	52	24
	W			96	67	45	16
254	S			123		59	
	B			110		56	
464	S		156			51	
	B		162			55	
	M		100			34	
516	M	174		86	70	44	22
	W	136		82	66	41	20

If the quarter note is taken as the basis of comparison it appears that the relative length of the other kinds of notes differs for the different subjects, and with the exception of S for the same subject in different selections. They are sometimes too long and sometimes too short. All the subjects make the eighth notes too short, sometimes very much too short, except M in hymn 516, where the ratio is exact. S, also without exception, makes the notes of higher denomination than the quarter too large. B, M, and W are less uniform than S, varying from the standard in both directions. Another method of testing the same matter—applicable in certain cases—consists in finding the number of instances in which the notes of other denominations are proportionately longer or shorter than the average quarter note of the same measure. The results of such a comparison are, however, with few exceptions in agreement with those just given.

Special Cases.

Triplets. In hymn 18 there are two triplets, one in the second full measure and the other in the last. Both take the place of unaccented half notes. All the subjects but M make the first triplet shorter than the average unaccented note, and all but S make the second longer. This last, however, is probably due to the approaching close of the piece. If each triplet is compared with the unaccented note of its own measure the results are conflicting, and the chances seem about equal that the triplet will be too short or too long.

Turning to the individual notes of the triplet there is a tendency to give more time to the second note than to the first, and more to the third than to the second. In the average results the second note in both triplets is made longer than the first by S, M, and W. This is not true of B, however, in either triplet. If the separate trials are examined, there are six possible chances for each subject to make the second note of the triplet longer than the first. S, M, and W do so 5 times, and B 3 times of the six. The last note of the triplet is made the longest of the group by all the subjects, and in all cases with the exception of M in the case of the last triplet where there are two trials in which this is not true. Thus while the tendency is slight to make the second note longer than the first, it is very strong to make the last longer than either of the others.

Dotted Eighth and Sixteenth Notes. The combination of dotted eighth and sixteenth notes in the second measure of the measures from hymn 53 presents an interesting study. All the subjects without exception made the whole measure very slightly longer than the ones that precede and follow it, though with such slight differences that the relation may be only accidental. Three of the subjects gave more time to the half of the measure containing the dotted eighths and sixteenths than to the first half. S made it 0.02 sec., B 0.08 sec., and M 0.03 sec.

greater, while W made it 0.01 sec. less. A comparison of the component parts of the last half of the measure with the average of the quarter notes in the first half of the measure shows a great lack of uniformity in the duration of both the dotted eighths and their combination with the sixteenth notes. On the other hand the sixteenth notes with two exceptions are all of too long duration. B and M each make the first sixteenth too short, but in both of these cases the dotted eighth with which the sixteenth is coupled is unduly long—longer than its proportionate part of the standard unit of measure, and longer than any of the other dotted eighths.

Accent.

Meumann, in his experiments upon rhythms executed in bare taps, found a marked tendency to hold the tap corresponding to the accented beat of the measure (*op. cit.*, p. 321), and Ebhardt reports something similar (*op. cit.*, pp. 126 and 127). The question naturally arises whether such a tendency appears in the musical records under discussion. Not all the selections contain such combinations of notes as to make determinations possible, but the number is sufficient to throw some light upon the question.

TABLE VII.

Showing in fractions of a second the average length of the accented and unaccented notes.

Hymn.	No. of Usable Notes.		Subject.	Average Accented.	Probable Error.	Average Unaccented.	Probable Error.
	Accented.	Unaccent'd.					
18	13	10	S	.893	.0053	.836	.011
			B	.926	.0063	.901	.011
			M	.744	.0043	.711	.0065
			W	.715	.0051	.690	.0063
254	22	22	S	.589	.0028	.591	.0040
			B	.557	.0036	.559	.0025
516	27	25	M	.454	.0033	.427	.0023
			W	.418	.0041	.404	.0048

Table VII gives the results for the trials in which the air only was played. In hymn 18 when all parts were played (see p. 38 above and the tables at the end of the article) there were 20 notes whose accent could be determined. 12 of these occupied positions of accent. The average duration of the accented notes was .898 sec., with a probable error of .0078, and that of the unaccented notes was .858 sec., with a probable error of .0099. These figures from the tests with all parts are for subject S alone. For reasons that will be given later no results could be computed for the tests with other subjects.

Comparing the lengths of the average accented and unaccented notes for each subject in the different selections it will be noted that in hymns 18 and 516 the duration of the accented note in every instance exceeded that of the unaccented one. Hymn 254, on the contrary, does not show this characteristic. Neither in the case of S nor of B is there any more than a small fraction of a thousandth of a second one way or the other. Accent does not seem to have affected the relative duration of the notes in this hymn at all.

The above computations were made upon note values corrected for the length of time the preceding tone overlapped the succeeding one (*cf.* p. 38). For purposes of comparison the average accented and unaccented notes have been calculated without this correction. This was done for all the subjects and for all three selections. The results, although showing the same general characteristics are far less uniform than before, the greater variation being caused by the great differences in the lengths of the overlaps. In hymn 254, however, there appears a slight tendency in the case of both subjects, S and B, to lengthen the accented notes which was not the case, as has already been noted, when the overlaps were subtracted in the usual way.

The relative lengths of the accented and unaccented notes may also be studied by counting in the individual records the number of times the accented note exceeds in length the unaccented note immediately following it. The results are expressed in tabular form in Table VIII, the count being made upon the corrected notes used in Table VII.

If the results for all the subjects are combined there are in hymn 18 one hundred sixty-eight accented notes. Of these 116 are made longer, 6 equal, and 46 shorter than the following unaccented note. Hymn 53 has 72 usable accented notes, of which 38 are longer, 6 equal and 28 shorter. Hymn 254 has 132 accented notes, with 60 longer (18 of which occur at the end of the stanza lines), 15 equal, and 57 shorter. Hymn 464 has 90 usable accented notes, with 43 longer, 11 equal, and 36 shorter. Hymn 516 has 162 accented notes, of which 99 are longer, 11 equal, and 52 are shorter than the following note.

It is evident from the foregoing that accented notes are often longer than unaccented notes of the same denomination, but it is also evident that this tendency is not present in all cases and with all players. One may conjecture that it will appear most prominently in pieces, *e. g.*, marches and processionals, which require a strong marking of the rhythm, and will be more or less completely absent in pieces of a more flowing character.

TABLE VIII.

Showing relation of accented notes to the immediately following unaccented notes.

HYMN.	SUBJECT.	WHOLE NUMBER OF ACCENTED NOTES.	NUMBER LONGER.	NUMBER EQUAL.	NUMBER SHORTER.
18	S	42	29	2	11
	B		30	—	12
	M		30	2	10
	W		27	2	13
53	S	18	12	1	5
	B		8	—	10
	M		8	2	8
	W		10	3	5
254	S	66	29	8	29
	B		31	7	28
464	S	30	15	4	11
	B		18	2	10
	M		10	5	15
516	M	81	54	5	22
	W		45	6	30

Intervals and Overlaps.

As already explained on p. 38 there were found in the original tracings many instances in which one note ceased to sound before the next began, and many also in which the first overran the beginning of the second. The first I have called "intervals," the second "overlaps." Both deserve a little fuller consideration.

Intervals. The intervals are of two sorts: 1. Those which occur between consecutive notes on the same degree of the staff, involving of course the same digital of the organ. 2. Those which occur between successive notes on different degrees of the staff. The first is much the larger class. Where two notes occur in immediate succession on the same degree of the staff a minute pause is necessary in order to make the two distinct. Such pauses occurred with all the subjects and in equal number.[1] The number of intervals of the second kind varies for the different subjects and for the different repetitions of the selections.

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[1] This, however, would not be true when playing all parts of the selection, for organists quite generally keep the key depressed during the whole time denoted by the several notes on the same degree of the staff.

TABLE IX.

Showing the number and average length of intervals of the first kind. Unit 1 second.

HYMN.	NUMBER OF INTERVALS.	AVERAGE LENGTH.			
		S	B	M	W
18	24	.084	.102	.071	.081
53	18	.131	.111	.050	.079
254	18	.138	.113	——	——
464	24	.078	.095	.099	——
516	54	——	——	.608	.088

TABLE X.

Showing the number and average length of intervals of the second kind. Unit 1 second.

	S		B		M		W	
HYMN.	NUMBER.	AVERAGE LENGTH.	NUMBER.	AVERAGE LENGTH.	NUMBER.	AVERAGE LENGTH.	NUMBER.	AVERAGE LENGTH.
18	13	.137	3	.017	0	0	11	.032
53	11	.128	3	.023	0	0	6	.015
254	15	.178	4	.057	—	—	—	——
464	7	.208	0	0	0	0	—	——
516	—	——	—	——	7	.023	14	.029

It is to be noted that the length of an interval does not depend upon the kind of notes in which the selection is written—that the intervals are no longer in a piece written in half notes than they are in one written in quarter notes. Subject S in most cases made intervals of the second sort to correspond with the pauses at the end of the verse lines, but this is characteristic of S alone.[1] These intervals are usually much longer than those of the first kind, and explain the great length of the intervals of S, in Table X. The other intervals of the second sort are short, and are probably accidental as they do not occur at corresponding places in the different trials. The characteristic of S in making intervals at the end of verse lines does not, however, seem to have affected correspondingly the time of the measures in which they occur, and this is one of the facts that make it uncertain whether the words really modified the time of the measures as explained above.

There is one exception to this statement. B in hymn 18, as already ained, p 41, made an exceptionally long interval at the end of the d verse line. Its average for the three trials is .363 sec.

Intervals have something of the nature of rests; they have little effect in increasing the length of a measure. The note just preceding the interval is shortened, and to be equivalent to a full note it must have added to it the value of the interval, as has been done for all the preceding tables.

Overlaps. Consecutive notes on different degrees of the staff are generally overlapped. This is probably done in the interest of smoothness. It is nearly impossible to make the end of the one tone and the beginning of the next exactly synchronous; and, if it were, the effect would very likely be less flowing than with the overlaps. Intervals on the other hand would give a staccato effect not desirable without special reason.

The overlaps are by no means uniform. Perhaps all that can be said is that if an overlap is large in one trial of any subject it is likely to be found so in the rest. The same two notes, however, may not overlap to the same extent even in different parts of the same selection. For instance, in hymn 254 g' and b' flat occur as consecutive notes three times, holding the same position in the measures and making in the course of the three trials nine cases where g' overlapped b' flat. The lengths of these overlaps given in hundredths of a second are for S, 1st trial, 6-7-8; 2nd trial, 5-5-4; 3rd trial, 8-9-3; and for B 1st trial, 6-3-4; 2nd trial, 5-5-6; 3rd trial, 8-6-6. In like manner c'' precedes b' flat three times, the length of the overlaps being for S 1st trial, 7-5-5; 2nd trial, 4-4-5; 3rd trial, 3-4-5; and for B 1st trial, 6-5-6; 2nd trial, 5-4-5; 3rd trial, 6-3-3. From the comparison of a large number of cases it does not appear that the number of degrees of the staff intervening between any two successive notes affects to any appreciable extent the length of the overlap.

The average overlaps for the three repetitions of the different selections have been calculated, and are as follows:

TABLE XI.

Showing number and average length of overlaps in fractions of a second.

	S		B		M		W	
HYMN.	NUMBER.	AVERAGE LENGTH.	NUMBER.	AVERAGE LENGTH.	NUMBER.	AVERAGE LENGTH.	NUMBER.	AVERAGE LENGTH.
18	71	.044	80	.051	90	.064	63	.030
53	70	.043	78	.049	82	.057	72	.026
254	124	.050	130	.044	——	——	——	——
464	91	.048	97	.053	96	.050	——	——
516	——	——	——	——	152	.063	133	.031

full measure, first note, the *g'* in the soprano was held by S 0.05 sec., and by M 0.12 sec. longer than the *d'* in the alto. In the third full measure, first note, S held the *b'* flat in the soprano in one case 0.03 sec., and in another 0.08 sec. longer than the *d'* in the alto, while B held the *d'* in the alto 0.06 sec., and M 0.02 sec. longer than the soprano *b'* flat. In the sixth full measure, first note, W began the *d'* in the alto 0.03 sec. before the *g'* in the soprano, while B began the soprano *g'* 0.01 sec., and S 0.02 sec. before the alto *d'*. The last note of the last triplet sounded longer than the *d'* in the alto in different instances as follows: 0.04, 0.05, 0.09, 0.04, 0.07, 0.15 sec. For hymn 53 the records contain similar instances.

RESULTS OF TESTS IN WHICH ALL PARTS WERE PLAYED.

As already mentiond Meumann has conjectured that the use of both hands in playing may result in greater precision in keeping the rhythm, and Ebhardt (*op. cit.*, p. 147) has found that the use of both hands quickens the general rate of execution. My own experiments furnish a certain amount of data on both points. Two hymns (18 and 53) were played by all the subjects, first as airs only, one hand being used, and then complete, both hands being used in the customary way. Each hymn was played three times as an air, and twice in the complete form.

General Rate.

The average time for playing the different selections was as follows:

TABLE XII.

Showing in seconds general rate when all parts were played.

	S	B	M	W
Hymn 18,	27.21	32.14	25.29	23.07
Hymn 53,	18.68	21.76	18.64	18.15

In hymn 18 the *c'* key was not connected with the writing magnet, hence the tone *c'* which occurs twice in the air of this hymn was not recorded, and the average time for playing the whole hymn is really larger than that given in the table by the time of two half notes. But even so if these times are compared with those required when the air alone was played (Table I, p. 39 above) it will be seen that in two cases more time was taken to play the selection when all parts were played. This is the reverse of Ebhardt's experience, and points to the need of further investigation of the matter with a view to discovering the effect of special conditions, and the range of individual differences.

The difference in the time of the two trials which the different subjects gave each piece when playing all parts is expressed in tabular form as follows:

TABLE XIII.

Showing in seconds the differences in rate when all parts were played.

	S	B	M	W
Hymn 18,	.74	.87	1.62	2.91
Hymn 53,	.41	.15	.46	.59

A comparison of the two trials shows that in hymn 18 the second trial was the shortest and the first trial the longest every time, and in selection 53 the first trial is shorter three times and longer once. In case of hymn 18 there is thus a contradiction of what was found in this regard where only the air was played.

The Measures.

The average length of the measures is larger than where the air only was played, and necessarily so since the total time is greater.

TABLE XIV.

Showing in seconds the average duration of the measures.

	S	B	M	W
Hymn 18,	3.52	3.99[1]	3.25	3.28
Hymn 53,	3.12	3.59	3.12	2.82

The following table gives the greatest variation between any two successive measures occurring in the individual trials. The figures in smaller type below each number represent, as in the case where the air alone was played, its value as a percentage of the corresponding average measure in the preceding table.

TABLE XV.

Showing in fractions of a second the greatest variation between any two successive measures in the individual trials.

HYMN.	S	B	M	W
18	.30 8.5	.19 4.8	.24 7.4	.23 7.0
53	.32 10.3	.15 4.2	.16 5.1	.27 9.6

---

here the same characteristic as was observed where the
layed (see foot note, p. 41), namely, that of making a
al at the end of the first half of the selection (the
nza). If this interval, which is .56 sec. long, is added
note according to the regular method of treating in-
ength of the measure within which it falls is 5.21
n this measure the length of the average measure

For the most part these differences are larger than when the air only was played; in case of subject B alone are they smaller. The average irregularities are as follows:

TABLE XVI.

	S	B	M	W
Hymn 18,	.095	.108	.108	.121
Hymn 53,	.155	.090	.080	.204

If these irregularities are compared with those for the same hymns when the air alone was played it will be found that the irregularities are on the whole somewhat greater when all parts are played.

The deviations of the individual measures from the average measure present the same general characteristics as when the air alone was played, but there is frequently a lack of correspondence in the signs of the deviations in the two ways of playing. The variations are also considerably larger where all parts were played. The deviations in connection with the fourth measure in hymn 18 are all plus, and show that the measure was retarded by all the subjects. The first half of the stanza ends within this measure, and it is within this measure, also, that the transition takes place from one line of the score to the next lower. In hymn 53 there is one set of deviations in which the signs are all minus, and one in which they are all plus, traces apparently of a tendency to begin each line of the verse or phrase of the music rapidly and then to retard. This is clearer in the trials with all parts than where the air alone was played.

The Notes.

The following table gives the average length of the different kinds of notes that are found in hymns 18 and 53 where all

TABLE XVII.

Showing in hundredths of a second the average length of the notes where all parts were played.

HYMN.	SUBJECT.	HALF.	DOTTED QUARTER.	QUARTER.	EIGHTH.
18	S	88		44	
	B	100		52	
	M	82		42	
	W	77		42	
53	S	119	75	51	26
	B	120	88	60	30
	M	98	87	53	18
	W	——	72	49	26

parts were played, and is to be compared with Table VI, p 43. In finding these averages all doubtful[1] notes were excluded.

A study of the relative values of these notes shows just as great variations as are to be found when the air alone was played. So far as can be judged from the half and quarter notes there is a tendency here to shorten the longer notes and lengthen the short ones In hymn 18, for example, when the average half note in the tests with all parts is compared with two average quarter notes S made the half note equal, B 0.04 sec. shorter, M 0.02 shorter, and W 0.07 shorter than two quarter notes. When only the air was played S made the half note 0.05 sec. longer, B 0.04 longer, M equal, and W 0.01 longer. A like comparison of the notes in hymn 53, where comparison is possible, presents similar relations.

Special Cases.

Triplets. The triplet groups in hymn 18, so far as the records could be used, present no striking differences from those in the same hymn when the air only was played. B, M, and W in the first triplet connected the first note with the preceding half note, thus making it impossible in case of these subjects to ascertain the whole duration of this triplet or the value of the first note. In all cases the last note of the triplet was given more time than the second. A similar characteristic was noted where the air alone was played. (See p. 44.) S, B, and M made the second note of the last triplet shorter than either of the others, while W made it longer than the first and shorter than the third. The variations here do not correspond in their relative positions with those that occurred where the air alone was played, and they are upon the whole somewhat larger.

Eighths and Sixteenths. The last half of the second measure of hymn 53 was more irregular in the tests with all parts than when the air alone was played. In all cases the part of the measure containing the combination of dotted eighths and sixteenths exceeds the amount of time given to the other half. The excess for the different subjects is as follows: S 0.11 sec., B 0.10 sec., M 0.07 sec., W 0.05 sec. The difference here is greater than when the air only was played as may be learned by referring to page 44. This relative lengthening of the shorter notes in the "all parts" playing is in harmony with the tendency [illegible] noted in the section on the notes, though the case is [illegible] clear. Comparing these elements with the [illegible] quarter notes in the first half of the measure we find that S and M made the eighth notes proportionately too short, and the sixteenths too long, while B showed a strong tendency to make both kinds of notes too long, and M was equivocal. Both B and M gave the second sixteenth note, that is, the tone *b'* flat, no separate individual existence. This was true for both subjects in each of the trials. The tracings show that the second eighth note, or tone *a'*, overlapped the third eighth note, or tone *c''*. In the case of B this overlap was 0.03 sec., and in the case of M it was 0.04 sec. The tone *b'* flat appears to have been played at the same time as tone *c''*, beginning with it and ending before it. It is quite possible that in playing these notes the two keys were touched at the same time, the *b'* flat key being fully depressed and the *c''* key only partially so until after the *b'* flat tone had received its full time, when the *b'* flat key was released and the *c''* key fully depressed. But the partial depression of the *c''* key was sufficient to cause it to sound and to give a record. This explanation seems to be verified by the great length of the *c''* tone for both subjects, which is not very different from the combined length of the first dotted eighth and sixteenth notes, that is, tones *a'* and *g'*.

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[1] [illegible] alto note was recorded in connection with a [illegible] instances the length of the note could not be [illegible] accuracy.

Accent.

In the selection where all parts were played the conditions are not favorable for determining what is true in regard to the relative length of the accented and unaccented notes. The subjects in accordance with instructions played in their habitual way. Three of the subjects in playing two or more notes that followed one another consecutively on the same degree of the staff depressed the key but once, keeping it down for a time equal to the duration of the whole group of notes. It was impossible to determine the value of other notes because with the means used for recording they were not separated from notes preceding or following them in the alto part. In hymn 18 note *c'* was not recorded at all. Subject S (hymn 18) gives the only cases in which the records can be used for this purpose. The results have already been given on page 45. They show, like those where the air alone was played, that the accented notes had a somewhat longer duration than the unaccented ones.

General Summary of Results.

Throughout the experiments there is a wide range of "personal difference."

When there was no intervening pause, or only a short one, there was in most cases a considerable variation between any two successive executions of the same selection. In such instances the smallest difference in general rate for any subject and for any selection is .17 sec., and the largest 2.74 sec. The tests indicate that a musician in playing a selection a second time is more likely than otherwise to play it at a slower rate than he did the first time, provided there is no pause, or only a short one, between the two performances.

The variations of the measures, also, are not constant. The difference between any two successive measures is frequently larger than 0.2 sec., while on the other hand it is often as small as 0.01 sec. There are, however, only three cases where the average irregularity amounts to 0.1 sec. The general irregularity is greater in the last half of the selections, but this is probably due to the terminal retardation.

The relative lengths of the tones were also variable, and do not follow exactly the ratios represented by the written notes. They were sometimes too great and sometimes too small.

A comparison of the triplets with the note occupying the other unaccented position shows that the chances were about equal as to whether a triplet was given too much or too little time. There was, however, a slight tendency to make the second note of the triplet longer than the first, and a strong tendency to make the last longer than either of the others.

In two of the selections containing such combinations of notes as to make determinations in regard to accent possible, there is a marked lengthening of the accented notes. In the other selection this characteristic is not present.

Intervals occur between successive notes on the same degree and on different degrees of the staff. Those of the latter sort are comparatively few, and, with the exception of those coming at the end of verse lines, are very short and probably accidental. When an interval occurs the preceding note is usually shortened and the length of the measure is not affected to any great extent. The number of overlaps is large; their length is far from uniform; and, like that of intervals, does not depend upon the length of the notes involved. In case of such small notes as eighths and sixteenths only a small proportion of the tone is without overlaps. The records indicate that in playing all parts of a selection the tones in every part overlap one another.

The results of the tests with all parts may be summarized as follows: The subjects executed hymns 18 and 53 with no greater accuracy when all parts were played than when the air alone was played. In some ways the results show a greater lack of exactness. The tempo is no better observed, the measures show a greater want of uniformity, and the errors in making the length of the tones of the different denominations are as large and as numerous. Meumann's hypothesis of a motor appreciation aiding the musician in his execution of the fractional parts of intervals is probably not far wrong, but my results do not support his conjecture that in playing with both hands one aids the other in giving to time intervals their correct relative lengths.

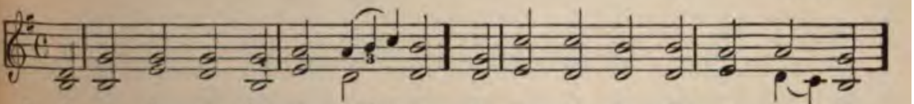
Below is given the scores of the selections that were played in the experiments.[1] In each case the average time values of the notes for the different trials are given in hundredths of a second.

Hymn 18 was transposed from the key of G to that of B flat because of the special tuning of the instrument, and played from the manuscript score.

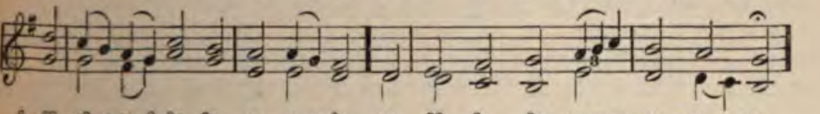
Air alone played.

18 All praise to Thee, my God, this night. L. M.

T. TALLIS.



S.	84	90	87	90	81	90	21	28	30	90	85	93	76	97	82	94	79	81
B.	91	96	91	95	89	84	25	24	40	89	86	93	89	96	85	92	84	201
M.	83	78	70	73	66	77	23	25	26	72	71	76	69	77	70	75	70	75
W.	68	73	67	72	65	74	19	20	28	71	73	73	68	73	65	73	68	76



S.	88	38	42	39	48	85	87	90	40	39	89	90	88	80	85	22	27	31	90	90	154
B.	88	46	44	43	45	95	94	94	42	42	91	98	91	97	94	27	25	41	96	94	194
M.	73	39	36	38	39	74	71	73	35	33	73	75	75	77	69	27	29	28	77	80	87
W.	70	36	34	34	35	70	68	66	34	35	71	71	71	74	67	22	22	29	70	76	177

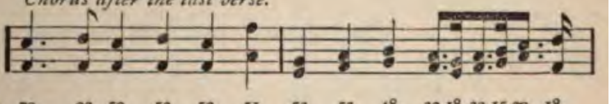
Air alone played.

Christmas

53 Shout the glad tidings, exultingly sing. P. M.

SECOND TUNE.

Chorus after the last verse.



S.	79	22	50	52	52	51	53	53	48	32	18	32	15	39	18
B.	82	23	47	51	55	53	50	51	51	41	9	34	18	39	19
M.	75	22	52	50	52	53	52	53	49	41	10	38	16	38	14
W.	72	15	44	44	43	43	43	45	43	29	13	31	12	29	17

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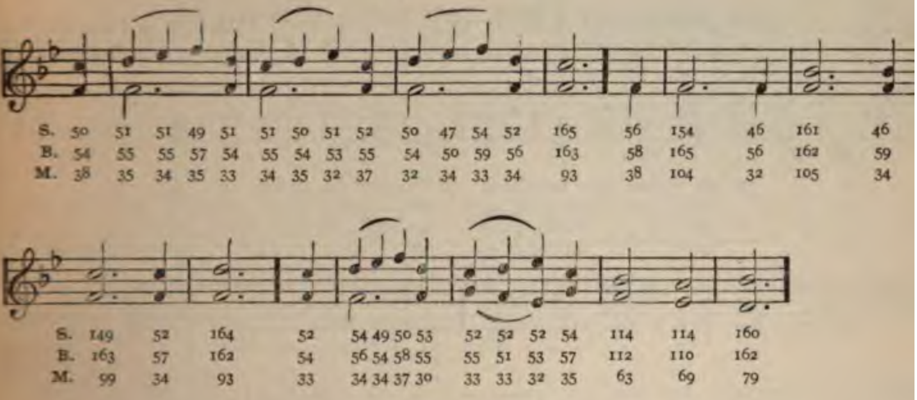
[1] For the electrotypes used, the writer is indebted to the courtesy of the Century Co., from whose Edition of the Hymnal the music was taken.

464.—Continued.



S. 50 51 51 49 51 51 50 51 52 50 47 54 52 165 56 154 46 161 46
B. 54 55 55 57 54 55 54 53 55 54 50 59 56 163 58 165 56 162 59
M. 38 35 34 35 33 34 35 32 37 32 34 33 34 93 38 104 32 105 34

S. 149 52 164 52 54 49 50 53 52 52 52 54 114 114 160
B. 163 57 162 54 56 54 58 55 55 51 53 57 112 110 162
M. 99 34 93 33 34 34 37 30 33 33 32 35 63 69 79

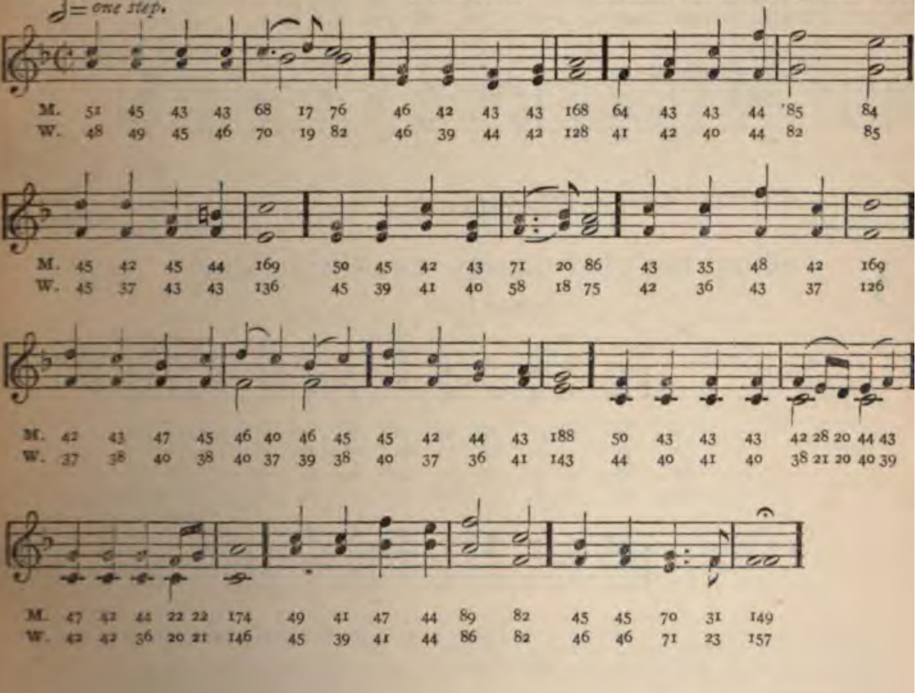
516 Onward, Christian soldier.

6.5.

Air alone played.

FIFTH TUNE.

Sir ARTHUR S. SULLIVAN, Mus. Doc.



M. 51 45 43 43 68 17 76 46 42 43 43 168 64 43 43 44 '85 84
W. 48 49 45 46 70 19 82 46 39 44 42 128 41 42 40 44 82 85

M. 45 42 45 44 169 50 45 42 43 71 20 86 43 35 48 42 169
W. 45 37 43 43 136 45 39 41 40 58 18 75 42 36 43 37 126

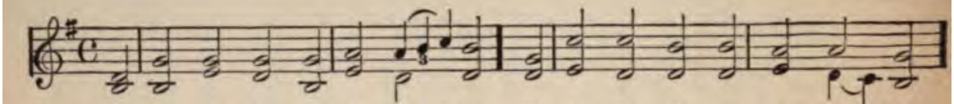
M. 42 43 47 45 46 40 46 45 45 42 44 43 188 50 43 43 43 42 28 20 44 43
W. 37 38 40 38 40 37 39 38 40 37 36 41 143 44 40 41 40 38 21 20 40 39

M. 47 42 44 22 22 174 49 41 47 44 89 82 45 45 70 31 149
W. 42 42 36 20 21 146 45 39 41 44 86 82 46 46 71 23 157

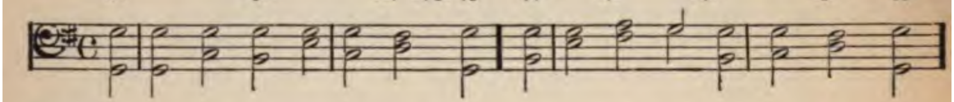
All parts played.

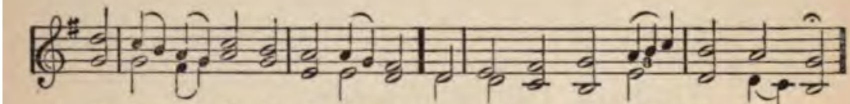
18 All praise to Thee, my God, this night. L. M.

T. TALLIS.

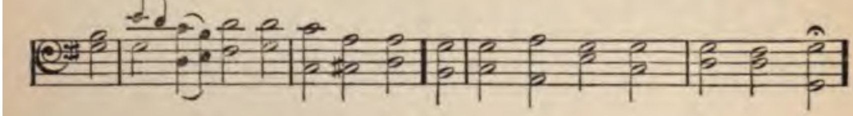


S.	93	89	88	83*	85	22	28	36	93	88	91	84	86	80	90	86	101
B.			384*			127	33	37	97	97*		202	101	97		198	219*
M.			326*			116	29	30	85	84*	84	78	84	78*	83	84	85
W.			290*			104	24	30	75	74*		148	146			158	79*





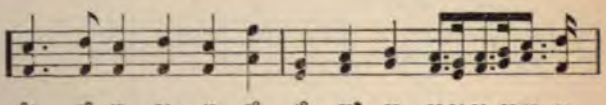
S.	88	45	44	47	45	88	82	88	44*	40	72*	92	92	86	33	18	39	94	93	178
B.	104	53	55	51	55	102	102		152*	49	106*	102	103	87*	34	26	38	101	108	192
M.	81	41	46	40	45	83	77	84	44*	38	85	80	83	79*	31	29	32	84	92	115
W.	74	40	42	42	42	80	77		119*	45	83*	81	86	77	23	25	37	84	92	238



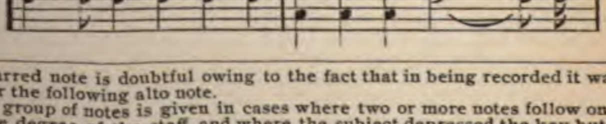
All parts played. **Christmas**

53 Shout the glad tidings, exultingly sing. P. M.

SECOND TUNE.



S.	84	28	47	54	49	58	48	50*	50	35	14	32	19	31	29
B.	92	29	59	57	59	61	58	67*	51	44	18	47	-3	59	18
M.	87	21	55	52	49	53	54	52	50*	39	16	39	-4	58	11
W.	72	13	49	41	44*	47	49	46	46	34	18	31	*17	32	15



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*The exact length of a starred note is doubtful owing to the fact that in being recorded it was n
rated from the preceding or the following alto note.
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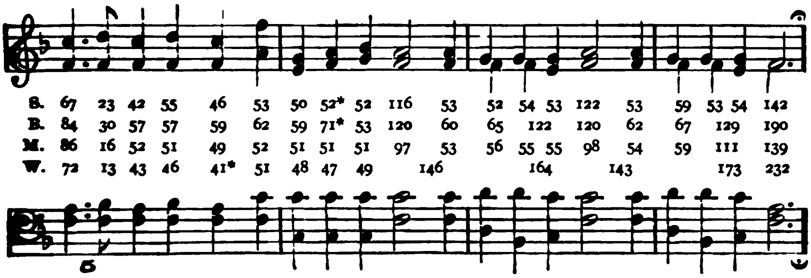
S. 67 23 42 55 46 53 50 52* 52 116 53 52 54 53 122 53 59 53 54 142
B. 84 30 57 57 59 62 59 71* 53 120 60 65 122 120 62 67 129 190
M. 86 16 52 51 49 52 51 51 51 97 53 56 55 55 98 54 59 111 139
W. 72 13 43 46 41* 51 48 47 49 146 164 143 173 232

RELIGIOUS EMOTION.

By H. B. Woolston.

Religion has been studied heretofore almost exclusively from the standpoints of history and of metaphysics. To these methods of procedure the recent interest in comparative religion has brought encouraging innovation. For only too long has the validity of a natural and universal sentiment been made dependent upon the historicity of certain documents, supposed to report the supernatural revelation of a particular faith, and upon the ability of a system of theology to demonstrate the finality of its dogma in the face of developing thought. Undoubtedly the historic origin of religious belief is of great importance in the study of its development. But who will tell us when we have come upon its first appearance? Surely the theoretical reconstruction of the primitive mind by latter-day philosophers betrays difficulties in the way of philogenesis, and the painstaking quarrels of historic critics should be a warning in the same direction. But whatever may have been the origin of religion, the fact that such a manifestation now exists is perfectly patent. No one can deny that there are millions of men all over the world who claim to hold religious faith, and who act in certain ways in evidence of this faith. Here, then, is a perfectly well established scientific fact: —religious faith does exist. Moreover, this faith manifests itself in certain phenomena that may be studied by us here and now. Therefore, just as the laboratory work of a student in modern biological science is considered of more importance for gaining a comprehension of the phenomena of life, than is mere acquaintance with the history of theories on the subject; so it seems to me that the study of the ontogenesis of religious
ith by the collection and comparison of data from original
d living sources, is of more importance for an understanding
the religious dynamic, than is labored exegesis or devotion
the history of dogma. By such method we may at least
rn something new about religion, and escape the dreariness
ere philosophic comment. And perhaps, when we better
rstand how religion works in life, we may more wisely
its activities.

gion may be studied genetically from several points of
Socially, religion manifests itself in ceremonies of the

cult and in certain institutional forms of activity. Intellectually, it has taken form in a body of more or less philosophical propositions called dogmas. But both these expressions in word and deed are objective, and more or less external to the real source of religious life. For modes of religious activity alter with changing civilizations, and systems of religious philosophy depend upon the intellectual culture of the people and of the time in which they appear. The constant element behind all these expressions is the religious experience as a fact of the inner life. This is the source of all external manifestations; this is the constant center from which spring divergent expressions. Since men's minds are essentially the same, if we can find what are the functional activities that express themselves in religious phenomena, we shall have the key to the explanation of the latter. For, as Dean Mansel says, "Whether the relation of man to God be primarily presented to the human mind in the form of knowledge, or of feeling, or of practical impulse, it can be given only as a mode of consciousness, subject to those conditions under which alone consciousness is possible. Whatever knowledge is imparted, whatever impulse is communicated, whatever feeling is excited in man's mind must take place in a manner adapted to the constitution of its human recipient, and must exhibit such characteristics as the laws of that constitution impose upon it."[1] Religion for us, then, is a fact of inner experience to be described in terms of psychic activity, and to be explained according to the laws of our mind's functioning. For this purpose we shall use as our tool the analysis that psychology supplies, reducing the elements, so far as we can, to terms of physiology, in order that the results may be made as objective as possible.

From this delimination of our problem it is clear that we cannot consider the social side of religion. It is undoubtedly the case that the social environment of the individual has the greatest influence upon him, both in determining the character of his ultimate standard of life, and in directing his activities in striving toward his ideal. The *rôle* that imitation plays in the formation of character has been amply shown by Tarde and Baldwin. Moreover, on the intellectual side, there are certain phases of religious faith that we cannot discuss here. Such are,—the content and the logical relation of the ideas that accompany religious experience. A train of ideas necessarily accompanies such experience; but it is clear that the character and relation of these ideas will vary according to the nature of the individual's past experience. Such intellectual content must be assumed in the experience, else the activity would have no sign to mark it off as religious. But it is not this side of the matter that interests us here. What we want to describe is the inner face of the experience; and, so far as we are able, the physiological machinery through which it is mediated.

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[1] Limits of Religious Thought, p. 92-93.

Now it must not be supposed that we are confusing the experience as *inwardly felt*, with the processes of its functioning as *objectively described*. True, it is the same activity; but to the person who experiences it, the religious emotion has a value quite different from that in the mind of the observer, who merely analyzes its manifestations as a type of psycho-physical phenomena. Moreover, as to the nature and existence of the objects of religious worship, we have nothing to say. That is a matter for the epistemologist and the theologian. Our business is with the inner experience, as such. In short, our problem is to give some account of certain emotions that have religious reference.

First, however, we must give some account of the emotions in general, in order that we may have clearly in mind just that phase of psychic activity with which we have to deal. There are several theories as to the nature of the emotions, but most of them agree so far: (1) An emotion is the inward feel of an experience, the peculiarly personal sense of an activity. (2) An emotion is the psychic resonance accompanying certain trains of ideas and certain bodily activities.

In the affective life an emotion corresponds roughly to a train of associated ideas in the intellectual realm. That is, an emotion is more than a mere sensation. To use a figure, an emotion is not a point, but a line of pretty definite form. On the other hand, an emotion is less completely organized than a sentiment, which may be considered as a fairly constant state of feeling corresponding to a well established intellectual attitude assumed in the face of certain situations. Perhaps it may be thought that in consideration of this last definition we should have done better had we started out to treat of the "religious sentiment." But what we shall have to say on the lack of co-ordination in the average religious experience may ustify our use of the middle term.

The main point in debate among the psychologists is as to e relation of emotions to bodily expressions. James and nge hold that the body reacts in a certain way to a given nulus, that the mind feels this state of tension or relaxation, that this feeling is the emotion. The older psychologists that the mind feels in a certain way immediately upon re- ng an internal or external excitation, and subsequently sses its emotional state by nervous discharges. Neither theories gives a very intelligent account as to why the n expresses itself in just the way it does. Perhaps the explanation of Professor Dewey would help out both at this point. He suggests (according to the first law of Darwin) that the nervous energies follow those channels which have been built up by the experience of the race in performing actions originally useful. As to the question at issue, it seems clear that genetically the physiological reaction does precede. Logically, however, the inner feel of an emotional stimulation must be appreciated, before the physiological accompaniments can be interpreted by the individual concerned, as expressions of his mental state. This doubtless is the point emphasized by the older psychologists. Personally, I should presume that it is the matter of sequence which Professor James is emphasizing, and not the identification of an emotion with its mere physiological accompaniments. At least the former point seems to me the only proper one for discussion. But if this interpretation be incorrect, and there is a more real dichotomy of mind and body involved in the views, then the remarks of Mr. Ribot apply. He says, both these theories are implicitly dualistic; one insisting on the causality of the physiological element, the other urging the precedence of the spiritual principle. But as a matter of fact, we know nothing of either element apart from the other. "Ce que les mouvements de la face et du corps, les troubles vaso-moteurs, respiratoires, sécrétoires experiment objectivement, les états de conscience corrélatifs que l'observation intérieure classe suivant leurs qualités, l'expriment subjectivement: c'est un seul et même évênment tradint dans deux langues."[1] We do not say that physiology is psychology, any more than we should be inclined to assert that the inside of a bucket is the outside. But just as the changes in a muscle may be expressed in terms of chemistry or described as physiological action, so it seems to me the working of the human mind can be expressed in terms of psychology or in those of physiology. Such at least seems to be the practical assumption of most alienists.

But leaving the vexed question as to nature of the interrelation of mind and body, the intimate connection between states of body and states of mind is universally recognized. I quote from Nahlowsky:[2] "Wie innig das Gemüthsleben mit der Verfassung und Entwicklung des Organismus zusammenhängt, zeigt der Umstand, dass leibliche Gesundheit oder Krankheit, Geschlecht, Nahrungsweise, meteoroligische Einflüsse, Tages- und Jahreseit, ja selbst die Lage des Körpers (also samtlich Verhältnisse, welche direct die Leiblichkeit betreffen), mehr oderminderauch auf das Gemüthsleben ihren Einfluss üben."

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[1] Psychologie des sentiments, p. 113.

[2] Gefühlsleben, s. 52.

tion, since there will be less internal friction to arouse affective resonance.

That religion on its inner side is a matter of feeling will scarcely be questioned. The work of Schleiermacher was to show this very clearly. He reduced religion in its essence to the feeling of absolute dependence. We should scarcely agree that this is a complete statement, but we cannot doubt that emotions such as fear, hope and joy play an important part in the development of the religious life. Perhaps the emotional element in religion will be sufficiently clear from a single quotation from von Hartmann.[1] He says, "Alle wesentlichen Momente des religiösen Processes gestalten sich zu psychologischen Zuständen, die wir nur als Gefühle zu bezeichnen vermögen; die Demuth der Endlichkeit vor dem Unendlichen, die Gottesfurcht, die der religiösen Weisheit Aufang ist, die Sehnsucht des Hertzens nach dem Göttlichen und seinem Besitz, diese folgenschwere Bewusstseinresonanz des noch mehr oder minder unbewussten religiösen Triebes, das gläubige Vertranen auf Gott und die selbtsverleugnende Hingebung der ganzen Persönlichkeit an ihn, die Qualen des Schuldbewusstseins und der Reue, die Verzweiflung des gottentfremdeten und mit Gott zerfallenen Bewusstseins, das Empfinden der von Gott gewährten Erlösung als einer wahr 'Erlösung,' das Durchkosten der tiefsten Erschütterung und der befreienden Erhebung, die Seligkeit der Versöhnung, die Gluthen der weltentrückten Andacht und die innere Sabbathstille des Gottesfriendens, dies und alles sonst nach zu Nennende sind ohne Zweifel nach psychologischer Klassifikation Gefühle." We do not intend to give a descriptive analysis of all these emotions in their religious bearing, but merely to present some account of how the more constant phases of religious emotion arise, how they manifest themselves, and what is their relation to bodily conditions.

First, let us see how religious feeling arises and develops in the individual. The religion of childhood and of primitive peoples is summed up pretty nearly in—fear of an external power, and hope of its assistance to overcome the disagreeable features of life. But with the growth of self-consciousness, there develops the sense of a more spiritual personal relation to the world about one. For as a man's sense of self develops, there necessarily accompanies it a perception of the not-self with which it is contrasted. And hence the necessity of establishing a working harmony between the two arises. Or perhaps it would be more nearly correct to say that a man's feeling of personality increases as, by growing knowledge of his environment, he is led to relate himself to the system of things in which he is placed. It is clear that both sides of this relation develop together. The perception of such relation and the endeavor of the individual to satisfy his wants in accordance with the laws of the world about him, reveals to him a hierarchy of powers within himself. That is, the satisfaction of some impulses does not give the same complete and lasting result for him as does the satisfaction of others. Consequently the individual is led to set a higher estimate upon activities of the latter sort. It is found that the activities which effect a lasting satisfaction for the organism as a whole have greater worth than those which attain the ends of a partial impulse or a merely temporary desire. Thus the individual is led to identify himself with the most comprehensive processes rather than with partial manifestations, and to set up as his ideal the satisfaction that arises from complete functioning of all his powers. And so a scale of values is established in the mind of the individual. For as his various activities express his whole personality more or less completely, they are recognized as good or bad for him. Here, then, is a personal ideal without as yet any very clear ethical content.

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[1] Religions-philosophie, Bd. II, s. 28-29.

But at the same time, the society in which the individual finds himself, prescribes that this ideal be of a certain type, and that the activities put forth in realizing it shall be directed along certain general lines. The principal feature about such a socialized ideal is its communal character. That is, the individual must not pursue his own selfish ends in a manner counter to the good of the group as a whole, but must realize himself as a member of the society, and must seek to advance the general welfare. This is a still larger ideal, which relates the individual to the social system, as his partial impulses are related to the development of his own personality. Certain activities of the individual that promote the common welfare are called "good," others that run counter to the functional activity of the group are termed "bad." The individual, by education and imitation is led to adopt this standard as his
to make it the test of his activities. Here morality

e more, the leaning of the group presents to the
a certain *weltanschauung*, in which good and evil
personal cosmic principle are pretty sure to have an
lace. The individual is supposed to sustain a rela-
cosmic society, just as he does to his own social
h relations are interpreted rather closely after the
he code of the group; but the regulations of this
ety usually transcend those of the earthly com-
may even contravene group *mores*. Such, for in-

stance, is the case of human sacrifice in societies where manslaughter is proscribed. In this cosmic relationship, we have the largest whole to which the individual can relate himself. Consequently the law of this comprehensive order (interpreted as the will of God), is made the ultimate standard for all activities. It must not be supposed that this standard is an absolutely fixed one. It is rather the outermost ring of a developing view of life, such as we have attempted to trace schematically in the two preceding sections. A sense of this larger ethical and religious responsibility seems to develop at about the age of puberty. It is about this time that most conversions occur,[1] that confirmation is celebrated, and that the rites of initiation into the social life of the group are performed.[2]

The appreciation of this ultimate standard brings with it certain added responsibilities to the individual. He brings his personality to the test of this larger ideal, and estimates the worth of his activities by their place in the higher co-ordination. Hence any conflicts between his activities and what he conceives to be the universal order (interpreted as realizing the will of God), is felt as a sense of sin. The more persistent partial impulses that are likely to drag him off from striving toward this more general end are regarded as evil. And thus a dualism is often established between the lower animal desires and the more intellectualized tendencies (the "flesh" and the "spirit"), or even between the entire present order and the idealized system (the "world" and "heaven"). The consciousness of such an inconsistency leads to a state of inner tension that must be relieved by the perception of a new synthesis and the discharge of partial activities in a larger co-ordination. The solution of the situation is perhaps most strikingly illustrated in what is termed in evangelical Christian churches, conversion. And to a consideration of this phase of religious development we now turn.

Leuba[3] and Starbuck[4] have so well described this crisis in the spiritual life, that we can do little more than summarize their treatment. The sense of inward dualism that we have just described is heightened by depicting the hideousness of sin and its ultimate punishment. On the other hand, the blessedness of following the will of God is emphasized by numerous testimonies. The individual is led to identify all his partial, lower and selfish desires with an evil self; whereas his higher and more generous impulses are attributed to a gracious spirit pleading within him. The figure of Jesus is pointed to as the realization of the unity between God and man, and his acceptance as a saviour urged. The emotional power of music, reiterated appeal from the pulpit, the example of others, the pleading of friends are added, until the emotional pitch often becomes intense. The ideas in the mind at such a time are restricted in number, and being constantly emphasized, come to possess it with almost hypnotic force. There is often great mental anguish and bodily disorder at such a time. Finally the individual can stand the tension no longer. He yields to what he believes is the will of God—that is, he identifies himself with the more comprehensive unity. He breaks with the narrower co-ordination of activities that has hitherto bounded his life, and throws himself into the "great sweep of things." He is no longer the main center of the universe, but has his place in its spiritual system. The individual's will now being in harmony with God's will, and all his activities co-ordinated in a comprehensive scheme, he proceeds in life with new confidence. There is often a sense of newness and change after conversion, since the lately acquired co-ordination is not the one that has heretofore been identified with the self. There is frequently also a feeling of joy and strength, due doubtless to relief from tension and a new redistribution of nervous energy. We are well aware that such a description applies to a particular form of religious life, and that there are others wherein no such striking transformation is effected. But, nevertheless, it seems to be the case that the acceptance of religious belief marks the process of relating activities to a larger scheme of life. Such a co-ordination may come as a matter of gradual growth, or be marked as a crisis relieving a conflict of tendencies.

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[1] Starbuck: Psychology of Religion.

[2] Daniels: The New Life, *Amer. Jour. of Psy.*, Vol. VI.

[3] Study of the Psychology of Religious Phenomena, *Amer. Jour. of Psy.*, Vol. VII.

[4] *Op. cit.*

The recurrence of periods of doubt mark less pronounced manifestations of this essential process. The conflict here is generally of a less radical intellectual sort, and usually arises from the failure of the accredited religious *weltanschauung* to comprise and harmonize certain additional views or experiences of life. Here again the emotional tension may be great. The "old self" is identified with the accepted statement or customary form of activity, the "new self" with the broader view. The incorporation of the limited form of functioning into that recognized to be more comprehensive again gives relief and freshness. The stress of feeling in such periods is not generally due to distrust of the religious desire as such, but rather to dissatisfaction with the limitations of its accepted forms of expression.

There are certain types of religious life and thought in which the emotional element has asserted itself to an unusual degree. This is especially the case in mysticism. The mystic is not satisfied to repose on any external authority, but would rise to a vision of God himself and hear the divine word within his own heart. "Pour cela, il est necessaire qu' il fournisse une préparation convenable; afin de s'élever aux choses du ciel, il faut que l'esprit se soit détaché de celles de la terre, et en outre qu'il se soit à la fois affiné et purifié par les austérités, la jeûne, les prières; d'autant plus que cet état cause des hallucinations, une prédisposition à l'inspiration. Si l'excitation est très grande et procure une sorte d'hystérie, l'esprit sera tout prêt à recevoir cette visite d'en haut. Elle viendra et l'homme sere inspiré, prophetisera, vera les esprits supérieurs, portera sur son corps les stigmates resultant de l'imitation par la volonte; il communiquera directment et extraordinairement avec Dieu."[1] It is true that this is a description of an exaggerated form of mysticism, but nevertheless of one that has been common to that tendency. The mystic goes apart from his fellow men, and seeks to find by absorption in the contemplation of God that unity which he feels is lacking in his life. The assertion of the common animal impulses is a temptation of the devil. The mystic would leave the prison house of his body, and rest in soul-to-soul communion with God. The exclamation of Maine de Biran—"Mon Dieu, délivrez-moi du mal, c'est-à-dire de *cet état du corps* qui offusque et absorbe toutes les facultés de mon âme"—is characteristic of a certain sort of mystic, and seems to point to a physiological origin of this tendency, *i. e.*, unharmonized functions striving for a point of unity and support.[2] Moreover, fixing the attention upon a limited number of ideas produces a state of emotion that corresponds to the nature of those ideas. This is the basis of the discipline of Loyola. This sort of self-hypnosis may lead even to an identification of the individual with the ideal form that absorbs his mind. In this way we may explain cases of stigmata. All stimuli are apt to be interpreted in the light of the controlling idea. Hence the frequency of illusions and hallucinations among mystics. It is highly probable that the organism of a saint, made sensitive by fasts and vigils, will respond readily to stimuli that would not affect a person in the ordinary condition. And it is very likely that many abnormal states of feeling will be objectively referred to spiritual causes.[3] If ecstacy or visions are of frequent recurrence or are accompanied by disease, we may expect to find a pathological condition as their immediate cause. Ste. Theresa, whose visions were most numerous, is known to have been epileptoid. However, we may not say that because men are susceptible to stimuli that we cannot appreciate, they are therefore abnormal in the bad sense of the word. Nor may we hold that a spiritual truth is useless because it was first discovered by a man whose mind was particularly sensitive in that direction.

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[1] Grasserie: De la psychologie des religious, p. 262.

[2] Murisier: Le sentiment religieux dans l'extase, Rev. Phil., '98. Charbonnier: Maladies des mystiques.

[3] See Joly: Psychologie des saintes, ch. 3.

There are two stages of mystic communion generally recognized by those who treat of this subject. The first is characterized by the perception of voices and visions, such as we have indicated. The second stage is that of ecstacy, or complete communion with God. This *ravissement* is often accompanied by motor impotence and sensory anæsthesia, so that there may be a feeling of levitation, or the soul may be felt to be exalted above the body.[1] It is an expansive feeling in which the distinction between the *me* and the *not me* is broken down, and the soul is wrapped in the Absolute. There comes a sense of oneness with God, untroubled by visions, unperplexed by obtruding ideas, which feels no fever of restless moral striving, but which is as a thrilling silence, as the throbbing of hearts in unison.[2] Since this stage is marked by the absence of clear ideas it cannot well be described in objective terms, but must be felt.[3] Sometimes the ecstacy is compared with the embraces of a consummated love. It will be seen that the emotional side of such *rapport* is very intense, whereas the intellectual and active phases are practically suppressed. It is all an inward quiver. There is another stage in the mystical development which brings it to its logical conclusion. It is simply "*aneantissement complet*," nirvana. There is no thought, feeling or action. Unconsciousness ensues, and the sense of personality is lost—" swallowed up in the Infinite."

The tendency of an emotional form of religion to adopt the practices of asceticism is well known. "They [ascetic practices] have been by all people adopted for the purpose of bringing on those abnormal states which are supposed to imply either possession by spirits or communion with spirits. Savages fast that they may have dreams, and obtain the supernatural guidance which they think dreams give to them; and especially among medicine men and those in training to become such, there is abstinence and submission to various privations with the view of inducing the maniacal excitement which they and those around mistake for inspiration."[4] The purpose of asceticism is to castigate or entirely suppress the less spiritual emotions. Distracting stimuli are shut off, and the attention is fixed upon religious ideas. External and internal aids are employed to keep these ever before the mind. Striking passages from the holy books are conned; physical means are used to induce the proper state of mind. Flagellation and uncomfortable clothing seem to act as stimuli, by throwing the desired religious consummation into strong contrast with present misery. Fasts are observed by many faiths, especially before great religious festivals.

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[1] See Murisier, *loc. cit.*, Comp. II Cor. 12: 1-7.

[2] See Ruysbroeck: Du supreme degree de la vie interieure.

[3] See Godferneaux: Le sentiment et la pensee.

[4] Spencer: Principles of Sociology, III, p. 91.

Perhaps a word should be said here about so-called miraculous cures, for such cases belong undoubtedly to periods of high religious emotion. It is possible, and very probable, that under stress of high excitement, the nervous forces may be gathered to overcome a functional disorder. It may also happen that under the suggestive influence of a religious rite the sufferer may temporarily disregard the disorder which later reappears.

The matter of revivals and of religious epidemics in general belongs rather to a discussion of social psychology than to a study of the emotions of individuals. We can only say, therefore, that an emotion is re-enforced by the perception of its social manifestation. A man may be convinced, a mob goes mad with conviction.[1] Perhaps we may dismiss this side of our problem by quoting from Granger.[2] "There is a natural exaltation of feeling when the mind directs itself upon sublime objects, but this is too often confused with the lower kind of excitement which is produced when human beings are assembled together in a crowd. This latter . . . . may be traced under the heads of contagion of feeling and hypnotic suggestion." A good or a bad emotion may thus be given momentum by gaining popular approval.

We now come to the question as to the relation of states of religious emotion to bodily conditions. From what has already been said of the emotions in general and of asectic practices in religion, it will be seen that the relation is a very close and real one. In fact we have held that states of body and states of mind are two descriptions of the functioning of one organism as regarded from somewhat different standpoints. Emotions are not entities controlling mind and body, but certain phases of the activities of these. Such being the case, the emotional states will vary with the varying conditions of the organism. And, hence, "religious states, as well as other states of mind, stand in reciprocal relation with states of the brain and nervous system."[3] As Mr. Joly says,[4] "Il me

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[1] See LeBon: The Crowd, Bk. I, Ch. 4.

[2] The Soul of a Christian, p. 101.

[3] Coe: The Spiritual Life, p. 86.

[4] *Op. cit.*, p. 160.

paraît impossible de nier ce que l'emotion doit aux habitudes d'esprit, à l'education bein on mal dirigée du raisonnement, aux tendances de l'imagination, aux ideés, enfin et surtont aux croyances. Mais on ne peut méconnaître davantage ce que la sensation des troubles physiques des mouvements circulatoires et des divers actes réflexes interessant chacun de nos organs aux modifications des tous les autres, apportent de proptitude on de langueur, de calme on d'intensité aux emotions que nous travaillent." Hear what Ste. Theresa herself says: "The disquiet of the soul comes most frequently from bodily indisposition. . . . . . The changes of the seasons and the alterations of the humors . . . often compel it to suffer in every way."[1] I venture to add yet another quotation from M. Murisier.[2] "La plupart des mystiques chrétiens reconnaissent que la misère, l'inquiétude, la tristesse de l'âme proviennent souvent de l'indisposition de l'organisme. Tant que notre âme est enfermée dans cette prison, elle participe à ses infirmités." It seems then that we have a pretty general recognition of the fact that religious emotions have an organic basis. And this we propose to demonstrate further from several lines of evidence.

(1) *The religious emotions are dependent upon certain constitutional and organic factors.* Mr. Coe has shown pretty conclusively by his investigations that the character of the religious emotions is dependent upon the temperament of the individual, and upon his susceptibility to suggestion.[3] Starbuck,[4] Hall[5] and Mercier[6] have demonstrated the dependence of the emotion upon the sexual condition. Indeed it is a well recognized fact that some sort of sexual mystery plays a part in almost every religion. But Starbuck has further shown the close connection between puberty and conversion. He also suggests that the ability to appreciate the very generalized relationships involved in religion is conditioned upon the completion of the third layer of transverse, or "associational" fibres in the brain.

(2) *Religious emotions vary in a fairly constant manner with certain meteorological changes and with bodily rhythms.* The evidence for this line of proof cannot be given here. The writer has been investigating the matter, and finds it to be the case. The results of the research, when completed, he hopes to publish at a future date.

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[1] Life, XI, 23.
[2] *Loc. cit.*, p. 461.
[3] Spiritual Life, p. 138 ff.
[4] Psychology of Religion.
[5] *Ped. Sem.*, Vol. I, p. 196 ff.
[6] Sanity and Insanity, passim.

(3) *The evidence of pathological conditions shows the connection between exaggerated religious emotion and diseased nervous states.* We may here remind the reader of the remarks made above under the heading of mysticism. Religious insanity has long been recognized. This is not generally attributed to devils nowadays, but is referred to a lesion or functional disorder of the brain. For a treatment of this phase of the subject we would refer to Kraft-Ebing,[1] Tuke,[2] Mercier,[3] Vallou and Marie.[4] We subjoin one case cited by Clouston.[5] He records a case of melancholia caused by amenorrhœa. The patient wept causelessly and bemoaned her fate as being a castaway from God. After five months treatment the patient menstruated, and recovery was immediate. The sense of religious depression and despair vanished, and religion did not trouble her one way or the other. Dr. Clouston adds, that persons of sensitive nerves and religious training are apt to hang their depression on a religious peg or doctrinal point.

(4) *Religious emotion is increased by the use of physical stimuli.* The employment of images and eichons to make the religious ideas clearer and to arouse the emotions of love, awe and reverence, has been common in practically every religion. Consider as examples, the figures of Budda, the crucifixes and pictures of the Passion in Romish churches. The use of music in religious worship has been almost universal. From the compositions of Handel and Bach to the war dance of the Dakotas we find the stirring effect of music employed to rouse the emotion of devotees. Perhaps such means of excitation, as well as the acts and attitudes involved in worship, may not strictly be called physical stimuli, since they lack that sort of immediate contact with an objective stimulant, which is frequently understood by the term. The forms we have mentioned, however, are doubtless physical enough in their source and in their appeal to the senses. But when we come to the use of incense and liquors to aid in exaltation, there is no doubt that physical means are being employed. The use of soma among the Hindoos to produce religious intoxication, and the inspiration of the Delphic priestess by means of inhaling gaseous fumes may be cited as instances. The use of the dance in religion to stir the feelings by rhythmatic action and to express the emotions in an expansive way is well known. The whirling dervishes and the ceremonial dances of the American Indians may be noted as examples.

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[1] Psyschiatrie, s. 85, 150, 326 f, 436 f, 521, etc.
[2] Dictionary of Psychological Medicine, art. Religious Insanity, etc.
[3] *Op. cit.*
[4] Des psychoses religeuses, Archives de Neurologie, 1897.
[5] Mental Diseases, p. 84 f.

In a very suggestive article in *The American Journal of Psychology* (Vol. VIII), J. H. Leuba defines the moral imperative as "a reflective, cerebro-spinal, ideo-motor process, unaccompanied (immediately) by sympathetic emotional reflexes." Hence we can understand the cold and "impersonal" character of the moral imperative, for it lacks that rich suffusion of organic sensations which we identify with the feel of our usual activities. The author suggests that the emphasis of various religions upon the "free spirit" as against the "heart of flesh," is nothing but the endeavor to keep the cerebro-spinal motor tracts free from the disturbing influence of the sympathetic system. If we comprehend all this, it is only a more psychological way of expressing what we generally admit—that those actions for which we feel a moral responsibility are those over which we exercise voluntary control; and secondly, that moral advance consists in progressively co-ordinating our blind impulses under intelligent direction. From what we have seen of the rich emotional accompaniments of religious experience, and in the light of these suggestions, we may appreciate with renewed force the psychological aptitude of Mathew Arnold's definition of religion as "morality touched with emotion." Religion thus involves the whole man; not only his well defined activities, but also the emotional presaging of larger co-ordinations that cannot yet be expressed in clear ideas or well directed effort.[1] *But the fact that intense religious emotion is accompanied by circulatory and visceral disorders,*[2] *and is marked by a paucity of clear ideas,*[3] *seems to point to the fact that nervous energies are being dissipated in the sympathetic system, instead of being profitably co-ordinated in the ideo-motor tracts.* While the vegetative processes are good so far as they go, it will be seen that domination by them is of distinctly lower value for the individual, and particularly for society, than is the execution of well directed voluntary activity.

What, now, are our conclusions as to the nature and value of the religious emotions? First, the religious emotions are the stirring of the forces deepest in the nature of man and inherent in the very organism of the human race. Religion is the voicing of a constitutional need, just as hunger is the feeling of a constitutional need. It is the desire to maintain and perfect the personality beyond its present natural limits. The warranty for religion is thus not a matter of external authority nor of intellectual inference merely, but it is found in the very structure of man as a sentient animal. If this be to materialize the spiritual nature of man, it is at the same time to spiritualize all of his nature. In this connection let me quote a passage from Professor James on the emotions.[1] "They are," he says, "Sensational processes, processes due to inward currents set up by physical happenings. Such processes have, it is true, always been regarded by the platonizers in psychology as having something peculiarly base about them. But our emotions must always be inwardly what they are whatever be the physiological ground of their apparition. If they are deep, pure, worthy, spiritual facts on any conceivable theory of their physiological source, they remain no less deep, pure, spiritual and worthy of regard on this present sensational theory. They carry their own inner measure of worth with them; and it is just as logical to use the present theory of the emotions for proving that sensational processes need not be vile and material, as to use their vileness and materiality as a proof that such a theory cannot be true." For my part, I should like to see the formal dualisms and watertight compartment systems of life done with, and life made a spiritual whole. Never will the higher nature of man be made the object of exact knowledge by super-refined and unreal methods of investigation. Only by painstaking empirical study can his experiences be rightly understood, and thus a sound basis be laid for the intelligent interpretation of his higher aspirations. Let me close such an apparently materialistic paragraph with the words of another.[2] "Shall we therefore conclude that conversion is practically an automatic performance? Not unless we first define conversion so as to ignore its profound relation to God and to the principles of a good life. If conversion is a *moral* renewal, it is not merely a psychical process of any sort. What has been proved is simply that, when conversion or an equivalent change takes place in one's moral attitude toward life and destiny and God, it may clothe itself in certain emotional habiliments provided certain factors are present, but otherwise not. The substance of religious experiences as far transcends their emotional forms as a man transcends the clothes he wears."

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[1] See Hylan: Public Worship.

[2] See Joly: Psychologie des Sanites, p. 164 f.; Murisier, *loc. cit.*

[3] Godfernaux, *op. cit.*

Let us next inquire what the office of emotion in the religious life is. The emotions as we have seen, are merely the psychic resonance of bodily or mental activities. They indicate the presence of unco-ordinated forces, and hence are especially marked on the breaking down of an habitual activity and the formation of a new co-ordination. An emotion is thus the stirring of forces that may be directed into a new and larger activity. But in themselves, the emotions may be as unmoral as a fever chill or as useless as escaping steam. It is the turning of force into intelligently directed action in accordance with the needs of the situation, that makes the dynamic of value. It is the co-ordination of the dissipated energies into a consistent scheme of development that gives them moral worth. Consequently the religious emotion as such has no value at all, except as the inward resonance shows ready response of the nature to a certain sort of influence, and except as the excitation leads to a large and worthy effort. Indeed luxuriating in religious emotion is a distinctly immoral practice, comparable with physical indulgence and dissipation. To quote from von Hartmann,[1]—"Wenn die Religion wirklich eine gewisse relative Beseligung des in ihr Lebenden mit sich bringt, so ist das jedenfalls doch nur eine accidentelle Nebenwirkung, aber nicht der Zweck ihres Daseins; wer dieses Verhältniss auf den Kopf stellt und den individuellen Gefühlsgewinn, weichen das Individuum aus der Religion schöpft, an die Stelle ihres objectiven Zweckes setzt, der leiht damit der tiefsten Wurzel alles Bösen und Antireligiösen, der endämonistischen Selbstsucht, einen gefählschten Freibrief, der schädigt die Entwickelung der Religion durch Konservirung und Stärkung der ihr aus der heidnischen Vorstufe noch anhaftenden endämonestichen Verunstaltungen." In other words, religious development is not to stop with a self-conscious gratulation at the pleasant stirring of new forces, but is to gain its real satisfaction by complete expression in proper activity in life. The weak and womanish aspect that the Christian religion has sometimes assumed from the undue emphasis upon the emotional side, has been amply scored by Coe.[2] So far as the emotion gives the enthusiasm of high endeavor it is good; so far as it becomes mawkish sentimentality it is execrable.

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[1] Psychology, II, Ch. 25.

[2] Coe: *Op. cit.*, p. 140.

Finally, what is the practical value of religious emotion in life? As we have seen, the tendency of the religious development is to take a man out from the narrow bounds of his limited personality and relate him to the whole of things. The universal tendencies are emphasized as against the more restricted; altruism is urged in the place of egoism; the more spiritual activities are recommended as against the lower animal impulses; and the realization of moral endeavor is guaranteed by the righteous power of God. This description, of course, applies to a highly developed sort of religious teaching. But some such striving after union with a higher power seems to be involved in all the forms. The self will always be a center of activity, but not necessarily the only center, nor the main one. If I might employ a figure, I should compare the frankly egoistic attitude toward life to a circle, where all radii lead to the "self-center." The social type of mind might be represented by an ellipse, wherein the interval between the foci represents the extent of the social or patriotic interests. The religious order would then be typified by a parabola, where the focus is still the ego, but the directrix reaches out into the infinite. This last figure cannot be said to be an exaggeration even as applied to primitive religions. For though savages may not have a very clear notion of infinity (such as our philosophers are blessed with), yet the outer limits of their system corresponds to this conception—as among all self-respecting peoples. Höffding has called religion the "cosmic vital" feeling. And that to my mind is the essence of the matter. "A man comes to realize the spirit that moves within him as a part of the whole. And a feeling of this vital oneness gives a certain peace and confidence which is religious in its nature if not in its form."[1] A man feels that his will is identified with God's will; that his plan is a part of God's plan. And such a feeling of *rapport* with the source of all power gives a man immense energy to suffer or to do. The religious emotion especially arouses the expansive manifestations of love, to which it is very much akin. And thus it leads to unselfish activity. The value of religion in enforcing morality and thus forming a strong social bond, has been generally acceded. The sense of living under the eye of an "ideal socius," or of existing as a part of God's very being, cannot help but have an exalting effect on a man's relations with his fellows. "En nous présentant la religion comme la lien unificateur par excellence ou la cause origenelle qui consolide et maintient le group social, nos prédécesseurs ne se trompèrent qu' à demi; car à la religion pour contenu essentiel ils donnarent l'amour des hommes et l'amour divin, la forme la plus large et la plus pure de l'altruisme." [2]

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[1] Religious philosophie, Bd. II, s. 52.

[2] *Op. cit.*

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[1] Stanley: Psychology of Religion, Psy. Rev., '98.

[2] Roberty: Le psychisme social, p. 47.

THE PSYCHOLOGICAL NECESSITY OF RELIGION.

By STEPHEN S. COLVIN, University of Illinois.

The future of religion is a problem which to-day is holding the attention of many thoughtful minds, and not without reason, for nothing can be more evident than that among the educated classes there is a general dissatisfaction with the present form of religious expression and content of religious dogma. The belief of our forefathers, simple but crude, is no longer found adequate, yet there seems to be nothing better to take its place. Many fear for the future, not knowing in what direction the evolution will tend, while others generalizing from the limited view-point of their surroundings, believe that a finality in this evolution has been reached, and that religion is to decay and finally die.

Of writers holding this latter view no one, perhaps, has given more forceful expression to it than Guyau.[1] He says: "Human beliefs, when they shall have taken their final form in the future will bear no mark of dogmatic and ritualistic religion. They will be simply philosophical." Again he writes of religion: "Born as it is of certain beliefs and certain customs, its fate is one with them."

As he regards religion in its inception as 'nothing more than an imaginative extension of human society, the explanation of things by a theory of volitions,' he concludes that its end will be a return to philosophy and morals.

In his belief concerning the approaching annihilation of religion as such and a substitution for it of speculative thinking and practical ethics, Guyau finds a wide concurrence. For example, Zola asserts that the world to-day is without mysteries. Empirical knowledge has taken the place of religion. Renan has a similar view, and replaces theology with science. John Stuart Mill sees the religion of the future satisfied with an enlightened morality. Even Henry Ward Beecher wrote, "Nobody ought to be called an infidel who sees in justice the great creed of human life, and who aims at an increasingly complete adjustment of his will to his moral sense."

On the other hand there are many who regard the religious consciousness as something fundamental and implicit, and although they conceive the possibility of any particular faith as passing away, they deny that religion as such can ever be eliminated or transcended. Count D'Alviella in the Hibbert Lectures for 1891 says that God may die as his thousand predecessors, Baal, Odin, Jupiter have died, and the Israelitish Yahveh must one day die, but what cannot die is the conception, enshrined in these names of a mysterious and superhuman power, realizing himself in all the laws of the known universe, revealing himself in the voice of conscience, and the spectacle of the world. It is needless to multiply examples. The radical difference between the two views set forth above is clear without expansion, and it is not the purpose of this paper to further emphasize them, but to enquire which of the two we may accept, and if neither as a whole how we may modify and harmonize them. In order to do this it will be necessary to consider more closely the essential nature of religion itself, that we may see if it has any psychological necessity for existence, or whether it is a phenomenon of human life relatively persistent and general but nevertheless transient.

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[1] "The Non-religion of the Future," New York, 1897.

But at the very beginning we are confronted with a difficulty. A logical definition of religion seems impossible, while even a descriptive definition is hard to formulate. At the outset we may, however, disregard certain attempts to explain religion by setting forth the phenomena which have attended its development. To declare that it originated in fetishism, animism or ancestor worship is to do little more than to name the occasions of its evolution, not to consider the underlying causes.

Turning to a more fundamental conception we may notice Edward Von Hartmann's view that the nature of religion and its source are to be found in egoistic eudaemonism. This statement, however, is so manifestly prejudiced that it need not be considered here. Neither can we assent to the rationalistic explanation of Wolff and his school who made religion logical thought concerning God. Kant's reduction of it to the basis of a moral maxim deprives it of vitality. Martineau's definition of religion as 'belief in an Ever-living God, that is, a Divine Mind and Will ruling the universe' is likewise too limited to include many of the phenomena that are usually classed as religious.

Both Max Mueller and Herbert Spencer find the essence of religion in the feeling of man for the infinite. Pfleiderer says that its roots "lie in the manner in which primitive man regarded nature and the emotions with which nature affected him." John Fiske says that the idea of God sprang from man's dependence upon something without him, and D'Alviella places its essence in the conception man forms of his relation with superhuman and mysterious powers on which he believes himself to be dependent. Finally Schleiermacher defines religion as the feeling of absolute dependence. These latter views agree in emphasizing the feeling element in religion instead of the rational, and in placing man over against an irresistible power which holds his very being in its grasp. On the whole Schleiermacher's definition seems the most satisfactory, but it must be taken with certain limitations. The feeling element which is made all important cannot be merely subjective. As Principal Caird has pointed out there must be a criterion outside of feeling to which we can appeal. On the other hand we cannot agree with Caird that "to place the essence of religion in feeling is self-contradictory." The feeling in which Schleiermacher seeks to find the germs of religion is that of individual helplessness when confronted by the universal power without, but it implies knowledge and will; knowledge as to the proper relation which the individual shall sustain to the power without, and the will which seeks to realize that relation. With these limitations, then, Schleiermacher's definition is accepted by the writer of this paper, and it is now proposed to show, (1) that this definition accords with what is known about the origin and growth of religions; (2) that this feeling of absolute dependence is the essential feature of the great historic religions of the present and the past, and finally that man is so constituted by nature and environment that he can never free himself from this feeling of absolute dependence, and as a consequence must always remain religious in the sense of the definition, and hence can never transcend religion nor convert it into a mere system of philosophy or morals.

It is a widely accepted view among anthropologists that religion originated in fear, and the first worship was an attempt on the part of man to get on the right side of those powers which man conceived of as being above him. This fear seems to have been of two kinds, first the fear of the unknown, the biological reason for the evolution of which is easily to be understood, and second the fear of the terrible and destructive forces of nature, the storm, the flood and the scorching heat. Naturally these two motives for fear blend in many instances and cannot be distinguished. Interesting in this connection is the fact that the first real gods were generally connected with the sky, suggesting both mystery and power. In the course of time it would be natural for man to create not only gods whom he should worship through fear, but also those whom he regarded as helpful, and whom he could trust. Thus two emotions, fear and love, are to be found in all religions of a relatively high development, although without doubt fear is the more original of the two, and forms a larger share of all primitive beliefs.

The point to be principally noted in this connection is that this conception of the origin of religions answers in part at least to the definition of religion which it is the purpose of this paper to defend. Such a religion as we are speaking of is essentially a feeling, and it is a feeling which objectifies itself, that is becomes an emotion, this emotion being based on the recognition of the dependence of man upon something without him. So primitive religion may well be defined as a feeling of dependence, though as yet the dependence has not become absolute. In order that it may become so another step in religious evolution is necessary. Man as purely naïve does not regard his dependence upon superhuman powers as any more absolute than he does his dependence upon his fellow men. It is only in a higher stage of reflection that he recognizes that he cannot flatter, cajole or get the best of his gods, as he does of his neighbors. Even in such a well developed religion as that of the Greeks this feeling of absolute dependence is slight in the earlier period of Mythology. Prometheus, the type of man rebellious and partially successful against the will of Zeus, is a product of unreflecting atheism.

Man originally was neither an optimist nor a pessimist, for both of these attitudes toward life presuppose reflective thinking. Yet we must regard primitive man as taking a real joy in life, and not becoming despondent under pain, for his consciousness had not been "sickled o'er with the pale cast of thought." But before he has reached a very high stage ot development, a strain of pessimism appears, and in pessimism, relative or absolute, is true religion born. For when it is recognized that there are ills from which human beings cannot escape by their own efforts, then comes the feeling of absolute dependence. Were the world perfect, or even relatively satisfactory, there would be no need of religion. But it is not, and it is in this radical imperfection that, as Schopenhauer puts it, is found the metaphysical necessity for worship of the divine. Man, says Von Hartmann, first believed that happiness was attainable for him as an individual, but he found this to be a delusion, then he said, 'though I cannot be happy, my children may,' but this he found also untrue; then in his despair he created heaven. So have thought the pessimists; but in a similar strain writes the great optimist Hegel in regard at least to this life when he says: "All that awakens doubt and perplexity, all sorrow and care, all limited interests of finitude, we leave behind us on the bank and shoal of time. . . . . . . It is in this native land of the spirit that waters of oblivion flow, from which it is given to Psyche to drown all her sorrows; for here the darkness of life becomes a transparent dream-image through which the light of eternity shines in upon us." Even John Fiske cannot regard this world as entirely satisfactory, and when he thinks of man in the light of his origin he cannot believe that this world is all. Life rests on mystery.

Turning to a consideration of the great historic religions we may first notice those of the East.

Among the deities of the Vedas stand forth Varuna and Indra, both deities of the heavens. Varuna especially was a god of mystery and power, a ruler whom none might oppose with impunity. Later in the philosophy of Brahmanism the Indian religion had passed beyond its unreflecting stage and plunged itself into mysticism. Man is completely dependent upon Brahma from whom he issued forth and to whom he must return. The world is viewed with pessimism. It is Maja,—illusion. Redemption is freedom from the thrall of the senses.

Buddha came more than five centuries before the birth of Christ, and presented even a more pessimistic view of the world, though he did not supplant in any way the Brahmanistic *Weltanschauung*. Life is an endless round of pain, to escape from it Salvation, Nirvana the *summum bonum*. The individual is nothing in himself, and absolutely dependent on the world principle.

"The dew is on the lotus: rise great Sun!
And lift my leaf and mix me with the wave,
Om Mani padme hum, the sunrise comes,
The dewdrop slips into the shining sea."[1]

Another Aryan religion, the Persian, has a pronounced strain of pessimism in it, with its world struggle between the good and the evil. Its fundamental character is well emphasized in the Book of Job.

The Greek religion as we find it in Homer is very naïve and childlike. The Greeks in the vigor of their youth and early manhood took too much joy in life to evolve a deep and powerful religion. They made their gods a little higher than themselves and intensely human, but above all—gods and men alike—ruled Fate from which none could escape. As civilization grew the priestcraft in the mysteries of Dionysius and Demeter developed a more spiritual worship, one calculated to stir the religious feelings to their very depths, and awaken the emotions of awe and fear in the dreadful presence of the Gods, as revealed to the neophytes through the trickery of the priests. The Greek enlightenment scoffed at the belief of the people, and the Sophists sought to do away with religion and morals alike, but Plato reasserted the worth of the divine and made the only reality that of the beyond, while the world itself was but a realm of shadows. Here pessimism in regard to the worth of this life powerfully asserts itself.

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[1] Sir Edwin Arnold: The Light of Asia.

Of the Roman religion not much can be said; it was in the later days at least mostly formal, but nevertheless its elaborate rites emphasized to a peculiar degree the dependence of the people on the power of the gods.

As the ancient civilization began to decay and as the world-despair grew, how inadequate proved mere philosophies; Stoicism, with its "renounce and bear," and Epicureanism with its grasping after pleasure. Both were thoroughly pessimistic, but neither offered any real escape from the evils of life. Then came Christianity and saved mankind from utter ruin, not by putting greater worth into this life, but by making the life to come the hope of the disconsolate.

The Hebrew religion from which Christianity grew represents the highest type of Semetic religions. "The fundamental trait of the Semetic belief in God," says Pfleiderer, "is that of his separateness from the world, oppositeness to man, who feels himself to be a powerless slave over against the overmastering deity." The Hebrew religion emphasizes this pessimism and dependence. No darker picture was ever painted of life than is found in Job and the Preacher. Yahveh, originally a storm god, is a being of vengeance and justice, but never of love.

In Islam Allah, is "an absolute almighty ruler, fearful in his anger, arbitrary in his rewards and punishments, his will incomprehensible and irresistible; he requires from men slavish subjection, and even this does not certainly secure his favor. . . To this dark view of the deity there corresponds a somewhat pessimistic estimate of the world; it is compared to a dung heap full of rotting bones; its misery is so great that it can only be surpassed by the tortures of hell."[1]

The religion of Christ in no sense does away with the pessimism of the Jewish faith in which it takes its roots, neither does it make man less independent of the heavenly power. In fact by doing away with formalism it makes the dependence more direct and subjective. It is not sufficiently recognized to-day what a deep strain of pessimism runs through the teachings of Jesus and the faith of early Christianity. This world and the kingdom of heaven were placed in inverse ratio, and it was only as the one was renounced that the other was to be gained. Further, Christ demanded an absolute renunciation, complete self-surrender and dependence upon God, and the early Christians understood his doctrine in this way. The world turned eagerly to Christianity because mankind was helpless. It is to be doubted that had Christ appeared a few centuries earlier when the world was more optimistic, if the religion of the Nazarene could have received such ready support as it did. Christ came indeed in the 'fulness of time.'

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[1] Pfleiderer: "The Philosophy of Religion," London, 1888.

The Christianity of the middle ages departed widely from that of the early centuries. Formalism took the place of the truer and deeper religion, though in æscetism and mysticism the spiritual fires were kept from going out.

It is hard to estimate the Christian life of to-day, but it is characterized by less of real dependence and surrender of self than that of earlier times. The feeling of the age, especially here in America, is not deep enough to turn the mind toward the transcendent. We are too much engrossed in the things of this world, too self-confident, too prosperous to think profoundly of the beyond. There is a great deal of talk to the effect that Christianity will be transcended because the world has progressed too far intellectually to longer accept the old-time dogma. To my mind the lessening of the religious life of the time is not a matter of intellect, but of feeling, and there is sure to be a rebound when a deep wave of pessimism sweeps over the world.

We have now reached the final question which it is the purpose of this discussion to consider; namely, granted that religion has been properly defined as the feeling of absolute dependence, can it ever be transcended or eliminated? The answer must be a decided no. And this for two reasons.

First, as we conceive it religion might be done away with if intelligence were perfect and knowledge absolute. If there were nothing left to be known, if all mysteries were cleared up, if we could see the whole plan of the universe unfold, whether it was for weal or for woe, then we might in the cold light of reason look at life without worshipping the power which controlled it. If its end were order and happiness then we might enjoy life in its fullness, and bear sorrow and pain with fortitude, seeing the good beyond; if, on the other hand, the end were mere nothingness, a return to original chaos, if all were without a plan and life without meaning, then we could become either Stoics or Epicureans. But an absolute knowledge is manifestly impossible. We can never know more than phenomena, and as the phenomena are infinite our knowledge must always remain infinitesimal. Too much value has always been given to intelligence. It is but a spark in the darkness. A large proportion of life is feeling, and we are always tending to lapse into the unconscious. Mere intellect can never hope to solve the mystery of the universe. Science when rightly interpreted has not removed mysteries, but revealed new ones. We know no more of the meaning of life or the destiny of humanity than did Plato. Moreover, it is unthinkable that we ever can know. In the presence of the riddle of the universe we may not always pause and reflect, but when we do, when we remove ourselves from the whirl of existence, the eternal question of life's meaning must impress itself upon us. He who imagines that reason can answer the demands of the human heart, has never deeply and profoundly thought.

Secondly, religion might be dispensed with were life satisfactory in itself, but that it can never be. Pierre Lasserre (in La Crise Chrétienne, Questions d'Aujourd 'hui, Paris, 1891,) maintains that philosophy and science have failed to solve the meaning of suffering. "There is more truth in the profound astonishment of simple souls when a great blow falls on them, than in any other attitude spontaneous or reflective. In that may be recognized the intuition of a natural mystery."[1] Eradicate pain, death and sin from the world and religion will be needless; as long as they remain there must be a profound pessimism running through life, and it is religion alone which will give this existence value for the countless thousands who toil and suffer.

We must not look at man in his strength alone and judge life accordingly; if we do our view is limited and narrow. The fields of drudgery, the hospitals, the prisons, the almshouses, the places of mourning; we must consider them as well.

On a sunlit September afternoon the chief of a powerful nation stands full of life, energy and assurance. The future is bright, the present seems secure. A week later in the darkness and silence of the night, with life at an end and the death agony already upon him the heroic sufferer murmurs, "Thy will be done!" How weak is man, how absolutely dependent on the forces about him—the plaything of circumstance, the sport of fate! Human life, passing from mystery to mystery, attended by pleasure, but also by pain, is not sufficient unto itself.

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[1] Quoted from *Pedagogical Seminary.*

RHYTHM, TIME AND NUMBER.

By ROBERT MACDOUGALL, New York University.

The experimental researches on rhythm of Bolton, Meumann, Ebhardt and others have familiarized us with the idea of interdependence between the factors of time, intensity, number and position in the rhythmical sequence. They have corrected our apprehension of the nature of the absolute intervals which enter as constituents into the simple rhythm group, and have shown these to be no fixed units, but variables whose magnitude fluctuates with every change in the index of variation in the limiting stimuli. They have made known to us that the time-relations of the sounds which compose music and verse are neither simple nor constant, that the proportions presented by successive notes or syllables are vastly more complex than the score or the metrical scheme indicates, and that their ratios vary with every change of emphasis, expression and mood in the speaker.

The plastic character of their elements commonly escapes our notice in the rhythms of speech and song. The changes of which we are conscious are those of verbal meaning, interpretation and emotional tone. It requires an attitude of artificially discriminative attention to discover even the variations in stress and tonal quality which are involved in the production of such effects upon the hearer, while the concomitant changes of temporal relations in emphasized words, in sustained and slurred notes, in significant and insignificant pauses, cannot be brought to light by any device of introspective observation. Every accentuation lengthens the sound upon which it falls, and every composition of an auditory series into a rhythmical unit transforms the apparent magnitude of the intervals which separate it from preceding and following groups. These expansions and contractions of duration vary in extent with the intensity of the sounds which support them, and in virtue of this constant functional relation they uniformly escape notice.

The process of rhythmical integration must therefore be taken into account as an important factor in every consideration of the phenomena of the time-sense and the means by which we apprehend and estimate series of successive impressions. Since our discrimination of durations is always of intevals bounded by limiting sensations, there is made possible the appearance of a process of rhythmical accompaniment wherever certain temporal conditions obtain among the successive stimuli of the series. If the latter thus originate a rhythmical mode of apprehension there will at once be introduced specific errors of estimation which will transform the whole nature of the intervals to be compared. The process of sensory rhythmization must therefore be considered first in its functional relation to general nature of the time-sense, and, if it be an indispensable factor in the estimation of temporal quantities, the effects of its various specific forms must further be discriminated in the analysis of the conditions under which appreciation of time-relations takes place, and of the factors which make for accuracy and inaccuracy in the process.

The relations of rhythmization to the time-sense are inevitably misconstrued by the observer who depends upon introspection for his results, and to this source is to be attributed the error of those psychologists who describe the sense of time as attaining its greatest refinement in the apprehension of rhythmical series. Thus Sully says, (Outlines of Psychology, Pt. III, p. 172, Am. Ed.). "It is, however, in the ryhthmic successions of verse and music that the ear's appreciation of time-relations shows itself at its best. The essential element in this experience is regular recurrence after a definite interval, or periodicity. Here an accurate measurement of time-interval becomes essential." The results of experimental observation contradict such an idea. There is present in all musical and poetical perception a characteristic transformation of time-values which makes the immediate comparison of successive intervals impossible. The estimation of absolute duration in rhythm depends finally upon factors which are themselves subject to variation. It is not the accurate measurement of successive intervals of time which is essential in rhythm, but the maintenance of proportionate relations among successive groups.

This preservation of time-analogies depends upon the capacity for a very nice reproduction of a succession of experiences of strain. Accurate estimation of time in music obtains only between intervals whose durations measure like strain experiences. Intervals bounded in the same way, or having similar functions in the musical sequence, are perceived and reproduced with great accuracy indeed; but no dynamically unlike intervals can ever be justly estimated as time-extents. Change the position of the given interval in the series of which it forms a part, alter its function in the rhythm group, increase or decrease the accentuation which its limiting sensations receive, and its psychological duration is immediately transformed beyond recognition. The same absolute interval has as many time-values commensurable with the period of this bodily rhythm, the lack of correspondence between their phases exerts a disturbing instead of a facilitating effect upon the process of time estimation. Münsterberg, in his work on the comparative estimation of successive durations, has emphasized the fact that there is no function of consciousness which can be called a special time-sense. Subjective standards of measurement are uniformly dependent upon physiologically conditioned changes, in sense-organ, muscle, respiration and the like. For periods of short duration rhythmical variations in the tension of the sense-organs afford the basis of our judgments; in the immediate apprehension of longer periods our estimates are chiefly determined by the functional rhythms of respiration. Rise and fall of tension, forming a completed wave of sensation, accompany each act of inspiration and expiration. According as the impressions coincide or fail to coincide with like phases of this process, the duration of their separating intervals will be judged clearly or confusedly; and according as they endure through equal or unequal multiples of this unit will they be judged to be equivalent or non-equivalent.

But secondly, all beating of time, whether or not consciously intended to embody a specific rhythm form, tends to fall into secondary rhythms by which the objective values of the intervals to be compared are destroyed as elements of presentation. Neither the centrally determined series of reactions nor that which seeks to reproduce an absolutely uniform succession of sensory impressions is free from rhythmic phases. The types of differentiation which such systems of reactions present affect both the intensity of its elements and their temporal relations. The definition and extent of such free rhythmization depend upon the absolute rate of succession among the stimuli involved, upon the quality of these stimuli, and upon the nature of the synchronous attention process. Its occurrence makes the process of time-comparison difficult, insecure and in any strict sense impossible. Attention must be renewed at every act if the series is not thus to be automized and fall into accentual groups. The moment inattention ensues, or the series is taken as a whole or in groups, the opposing phases of rhythm appear. Either, therefore, the process of motor adjustment requires attention and the judgment is displaced, or it is automized and the material of judgment is transformed in value. In both cases the accurate discrimination of duration will be seriously interfered with.

The phenomena of mechanized motor impulses seems thus to be essentially antagonistic to the process of time-discrimination. On the contrary, it is upon the phases of such rhythmical processes, in the last analysis, that not only forms of æsthetic apprehension but the sense of time itself depends. Contradiction appears and the capacity for correct discrimination is destroyed only when the intervals to be compared are bounded by dynamically unlike limits. The reproduction through a motor process of the intervals to be compared, which is spontaneously established in the presence of exciting stimuli, is indispensable to the function of temporal judgment. Horwicz calls rhythm the only measure of time, and ventures the assertion that a being whose experience did not manifest periodicity could gain no conception of its nature. Time does not make rhythm, but rhythm time.

Such phases of generally rhythmical change may belong to either of two categories, namely sensation and movement ; and theorists of the time-sense have severally based their derivation of its phenomena upon each of these. Thus Lipps connects our judgments of time with the process of fading which the course of sensations manifests, qualitative differences in the elements of consciousness being translated into concepts of temporal order and value. But such experiences are qualitatively rhythmical only, and give no adequate basis for time comparison ; for the series of external stimulations is without any sufficient principle of periodicity, to some form of which the phenomena of the time-sense must finally be referred.

Within the organism itself such rhythmical changes are abundant, and to these facts the majority of observers have turned for an explanation of temporal judgments. There are certain constant conditions of feeling, as Waitz points out, which characteristically accompany these processes of change in sensation or other conscious content,—straining of the attention, feelings of expectation and surprise, of impatience and tediousness,—and it is to these, not to the disorderly palimpsest of fading sensations, that we most hopefully look for an understanding of the facts of time-estimation. "This theory of temporal signs," writes George C. Robertson (referring to Dr. Ward's view of movements of attention as temporal signs), "may fairly be regarded as the most interesting contribution to the subject since Herbart."

Wundt likewise connects the process of accurate time-estimation with primitive types of rhythm in the bodily activities. He points out the fact that the interval of time of which we have the clearest grasp as an object of sensible intuition, judged by the degree of sensitiveness to variations in its extent, is just that which Weber had observed to be the average time occupied by the leg-swing in rapid walking. We can estimate such periods best because the laws of our physical organism make it most easy to mark time to them by some form of organic adjustment or motor reaction. The value of this period is variously given by different experimental observers, as follows: Mach, 0.375 sec.; Stevens, 0.71 sec.; Kollert, 0.755 sec.; Mehner, 2.15 secs.; Vierordt, 3-3.5 secs. Of these only two (0.71 and 0.755) present even a moderate approximation to each other; but through the whole series runs a fairly defined periodicity. The unit of this rhythm is not the value ordinarily assigned to the period of most accurate estimation,—three-quarters of a second—but about one-half of this. All the subsequent members of the series, if we include Vierordt's results, which present rather the indifference-point at which the tendencies to over- and under-estimation disappear, embody this primary period. It seems probable, therefore, that the duration most accurately estimated is one including both phases of a complete rhythmical change.

As to the special processess of adjustment involved in the apprehension of temporal quantities there is probably no last word to be said, in so far as the phenomena of time-estimation are not necessarily correlated with any one type of organic change. Horwicz considers that all the rhythmical functions of the body serve this purpose in turn,—respiration, pulse, movements of the legs, jaws, etc., and the alternations in larger rhythms of hunger, sleep, work and the like. The immediate apprehension of time is, however, to be understood only in connection with rhythmical changes in the organism of imcomparably shorter period than those of sleep and waking, labor and rest. Of these shorter rhythms most stress has been laid upon respiration and the beating of the heart. Leumann compared the natural rates of reading verse in different persons with the normal periods of their pulses, and found that one with a pulse of eighty-five beats per minute read one hundred and seven metrical feet in a minute, while one with a pulse of ninety-eight read at the rate of one hundred and twenty-nine feet. He found also that the pulse of a single subject changed from seventy-seven, when scanning one hundred and thirteen feet per minute, to eighty-three when scanning one hundred and forty feet. With changes of this type Leumann connects the
mena of attention waves, and what James calls "the
al sharpening of our time-sense."

considers the time-sense to be as special as that of
He surmises that its organ is to be found in the mech-
the ear; that processes of accommodation are set up
ns, varying with their intensity, duration, etc.; and
the phases of such adaptation has originated the
of succession and duration, analogous with the
distance and perspective by the eye. It is ques-
ear is an analogue of the eye in this regard.
of visual space-perception are derivative in their

nature, and represent certain primary successions of motor sensations involved in the exploration of the external world. But this set of secondary perceptions is exceedingly well organized and independent. In various animal types it presents a system of sensori-motor adaptations organized in advance of individual experience and depending upon the inherited assimilative formula of the organism itself. In human perception all pronounced motor interpretation has fallen into abeyance and we depend in a very complete fashion upon immediate visual sensation for our representation of space-relations.

If we assume the ear to be capable of analogously becoming the organ of time-perception, it is still only as a secondary mechanism the changes in which are representative of certain primary experiences of tension and release. Such substitutionary agencies arise only in virtue of the greater sensibility or control of special organs, and development by no means exists here in any such degree as characterizes visual space perception. Introspection reveals the existence at every point of wide-spread rhythmical tensions and releases in the organism, as the accompaniment of all attentive time-estimation. The inhibition of these, or the contravention of their phases, means the mutilation of our time-perception. Whatever may be the possible future development of auditory function in the apprehension of time-values, the process is still intimately bound up with these primary sensations of tension and movement themselves.

In so far as the element of organic adjustment is concerned in the appearance of time-values it must be recognized that this process cannot be localized in a single mechanism, such as the ear, without presupposing an evolution for which there is little empirical justification. The estimation of time is in no way restricted to auditory experience; one judges as readily,—if not so accurately—the length of flashes in a coast-wise light as the duration of tones in a siren. The qualitative content is indifferent, and the variety of organic adjustments is as great as the number of senses which may be specifically involved. The essential point of the matter lies, not in the quality of the sensations or character of mechanism involved, but in the phenomena of general attentive adjustment common to all these processes alike. The root of the matter is reached by Titchener when he says: "When we try to discover by introspection what means we have used for our comparison of two durations of this third kind (one-half to three seconds), we find that strain intensities have played a great part in the formation of the judgment. The strain sensations come 1, from the expectant attitude of the whole body, and 2, from the adjustment of the sense-organ to the stimuli which limit the intervals to be compared. We estimate duration in terms of intensity: the more intensive the strain, the longer must the interval have been; the less the strain, the shorter the time."[1]

The process of rhythmic integration is fundamentally involved not only in the estimation of relative duration in time intervals, but also in the numerical apprehension of serial impressions beyond very simple groups. Our immediate apprehension of number in temporal series is exceedingly weak, and extends at most to groups of half a dozen members. If the rate of succession be sufficiently low counting may be employed, and there is then no limit to the number of impressions of which one may keep tally; but this is in no sense the apprehension of a series. Each impression is perceived and named separately, and the process involves, in addition to this, only a memorizing of the final name uttered,—an ordinal term which becomes a symbol for the sum of the whole series.

The apprehension of a serial group is wholly unlike this. We can grasp only those series of impressions which are either so simple or so highly co-ordinated as to have a distinct form for our consciousness. Simple groups which are so characterized extend to four or five, possibly half a dozen individuals. Beyond this we fall back upon the process of rhythmization, the result of which is to extend such figuration to larger and larger series. We identify twenty-five impressions as we identify five; when the series is increased beyond the limits of apprehension as a group of individual elements we can estimate its number only when the conditions are such as to allow of the substitution of groups for elements as units in the process of apperception. What we recognize is not a larger number of units but a like number of units of a qualitatively different kind. They are such as we call "three-beat," or "five-beat," or "two-fours-beat" groups. The identification of the unit-group in such a case is as immediate and secure as the recognition of simple beats, or elements of any kind. The naming of the whole series as "ten," or "twenty-five" or "forty" strokes, is a secondary interpretation of the significance of the immediate apprehension. The form of the "twenty-experience" or the "forty-experience" is recognized as is that of any rhythmical sequence, and subsequent analysis alone translates that qualitative series into numerical values. Without this rhythmical emphasis and grouping such estimation would be absolutely impossible. The scope of this temporal consciousness depends upon the complexity of the units which enter into it. "Forty strokes might (then) be remembered as a whole, and identified without error when repeated, provided the mind grasped them in five sub-groups of eight, or in eight sub-groups of five strokes each. When no grouping of the strokes beyond making *couples* of them by the attention was allowed—and practically it was found impossible not to group them in at least this simplest of all ways—sixteen was the largest number that could be clearly apprehended as a whole."[1] The particular number-groups apprehended with the greatest ease are those most readily subdivisible into rhythmical units; the most difficult are the prime numbers. "Series of 4, 6, 8, 16 were more easily identified than series of 10, 12, 14, 18. The latter could hardly be clearly grasped at all. Among odd numbers, 3, 5, 7, were the series easiest caught; next, 9, 15; hardest of all, 11 and 13; and 17 was impossible to apprehend."[2]

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[1] An Outline of Psychology, Cap. IV, p. 87.

Such auditory series cannot be grasped at all if their succession falls below a certain rate, for beyond this limit the human consciousness has no capacity for rhythmical integrations of its impressions. When their succession rises above a certain other superior limit the numerical apprehension of the series of impressions again becomes confused, for while the rhythmic form still persists, the number of elements which are crowded into each simple group can no longer be discriminated. The range of rates within which such rhythmic integration is manifested in combination with clear discrimination of constituent sounds lies between two seconds and one-tenth of a second. The most favorable rate appears to be slightly more rapid than that instinctively adopted in free rhythmical tapping. This is due, I believe, to a difference in the mechanism of accompaniment in the two cases. The muscle system employed in beating out a rhythm with the finger presents a greater inertia than is involved in accompanying a sensory series by motor discharges which affect only certain parts of the vocal apparatus.

The limits of our capacity for estimating temporally extended periods or numerical series are to be looked for in the physiological laws which condition motor discharges on the one side, and make it possible or impossible for us to imitate the objective series by a system of organic strains; and on the other hand, in the limits placed upon our discrimination of refined experiences of strain due to perception-reflexes taking place in some part of the bodily organism.

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[1] Dietze, summed by James: Psychology, I, Cap. XV, p. 613.

[2] *Op. cit.*, p. 613.

MENTAL LIFE OF TWO *MACACUS RHESUS* MONKEYS IN CAPTIVITY.—I.

By A. J. KINNAMAN, Fellow in Clark University.

INTRODUCTION.

To Dr. Edward L. Thorndike, of Columbia, belongs the honor of having first taken the monkey into the psychological laboratory. He experimented for several months with three *Cebus* monkeys from South America. His methods and work have been made a starting point for the following studies. In my experiments two *Macacus rhesus* monkeys from India have been used. This species is peculiar in that it is a connecting link between monkeys and baboons. It is a favorite among trainers, and is regarded as very intelligent, though not so intelligent as the *Cebus*. No extensive studies have yet been made of it from the standpoint of psychology. Cuvier, however, gives a charming story of a mother *Macacus rhesus* and her young. Not having access to the original report, I have translated it from Brehm, and the translation will be found in the appendix to this paper. So far as I know his is the only careful study yet made of any of the psychical qualities of the *rhesus*, though there are extant many scraps of information concerning them of more or less scientific value.

I wish here to thank President G. Stanley Hall for suggesting the investigation and for valuable assistance in procuring the literature of the subject. I owe acknowledgment to Dr. E. C. Sanford, likewise, for numerous suggestions, and assistance in procuring and arranging of apparatus, and for help and
n both in the experiments and in the evaluation of them.
so to thank Mr. Wilson, the Librarian of the Univer-
ssistance rendered in the library, Dr. Hodge for the
fine camera, and many others for valuable assistance

THODS OF COMPARATIVE PSYCHOLOGY.

METHODS OF SECURING DATA.

rded the methods of studying animal psychology
s: (1) the natural method, consisting in careful
s observations of the free life of an animal. In
ong Huber, Moggridge and McCook on ants,

Audubon on birds, Figuier on insects, and Mill on our domestic animals; and (2) the experimental method, which consists in putting a question, and subjecting the animal to such conditions as will favor the performance of activities that shall contribute material for answering the question asked. While the classification is a correct one I desire to divide still further, and to indicate five methods of studying the characteristics and capacities of animals. Each has its advocates, and valuable results have been obtained by all of them. Some render only qualitative data, others both qualitative and quantitative.

(1) *Free observation of animals in their native habitat.* Disciples of this plan are to be found in Ernest Seton Thompson, W. J. Long, Paul du Chaillu, John Burroughs, Lubbock, Audubon and Forel. The first four of these are literary. While they attempt careful observation of the animals, they do not hesitate to read into them all sorts of feelings and mental capacities, surpassed only by the fertile imagination of Uncle Remus. The method from a literary standpoint fully commends itself, but such studies must not be mistaken for science. If the method is to add anything to the stock of human knowledge the literary observer must take the greatest care to keep the foundation of his work entirely within the field of truth. But adding to the sum of human knowledge is not the only outcome of study worthy of attainment. The literary observers are adding a rich fund to the sum of human sympathy and interest, and that is enough so long as in making that addition fundamentally false conceptions of the real animal life are not inculcated.

But from a purely scientific standpoint also, this method can be made to bear first-class fruit. It has the advantage of seeing the real animal in his natural, unhampered reactions. Lubbock and Forel studied the smaller animals and insects in this way. It is an easy matter to bring whole colonies of these under direct observation and yet to leave them much of their native freedom. The larger animals cannot well be studied by this method. It can hardly, save for the lowest forms and smaller animals, ever be more than qualitative in its results, though Lubbock has demonstrated that for ants, bees and wasps the method can be made to yield both qualitative and quantitative results.

(2) *The second method* is ably presented by Wesley Mills in his *Animal Intelligence*, p. 7. A single quotation from him with reference to the study of a dog will give a fair idea of the method which he proposes and uses.

"Not only is it necessary in order to understand the individual dog to begin with him at his birth and to follow his history throughout, but such a course is essential for the comprehension of the nature of dogs in general, and, personally, I am deeply convinced of the importance of such investigations, after having been engaged in them for some years." In other words the young animal is to be studied rather than the adult, but the study is to comprehend his gradual development as well as his reactions in his natural environment. "When such studies are carried out on representatives of different groups of animals, and on different breeds or individuals, one's conception of the true nature of animal intelligence—or, to use a more comprehensive term, the psychic life of animals—is vastly widened and altogether more correct in every respect."

The method is invaluable in a study of instincts, individual differences, growth, development, and the influences of environment. No other methods can hope for results more significant for genetic psychology and education. The stages of development can here be seen to pass along from germ to maturity in very rapid succession. Yet attempts to carry its results over into the realm of human activities are always to be guarded with great care. If students of animals are always in danger of reading their own processes, unduly, into the animals that they study, those that apply the results of such studies to human conditions are similarly liable to read animal conditions into the psychic life of man. It will be recalled that Comenius, probably more than any one else, in this way, made nature the criterion of methods in a somewhat characteristic pedagogical scheme.

However valuable this method, it has its limitations. While it brings out what the young animal *does* it omits both what it and the adult *can do*. Only a limited variety of animals can be so studied at all, and a still more limited number, while reacting unhampered by human hand in their relation to their natural parents. The method has been successfully applied in studies of chicks, kittens, puppies and squirrels.

(3) *Training*. This method is presented by P. Hachet-Souplet in his *Examen Psychologique des Animaux*. He proposes to study the animal by training it, holding that rational training multiplies for the animals, especially for the superior animals, that is to say the most interesting ones, the occasions for bringing into play, before the observer, their intellectual and instinctive faculties, enabling him not only to arrive at significant conclusions but easily to verify them. The animal is to be brought by repetition to such a stage that he shall know by a verbal order or by a gesture from the trainer just what he is to do. Thus we have the animal studied in action. The method reveals but little beyond the powers of memory and association. Hachet-Souplet proposes that animals be classified on the basis of psychic capacities and that suscepti-

bility to training be taken as the proper criterion for determining mental capabilities. On this basis he makes three classes of animals. (1) Those capable of being persuaded to perform their parts. Such are said to act chiefly through intelligence. (2) Those which cannot be persuaded but must be coerced. These are said to act through instinct. (3) Those in which excitation only is possible. They possess, evidently, neither intelligence nor instinct, they are simply excitable and live without psychic direction, only by repetition of physical and chemical phenomena, which determine and continue their nutrition and reproduction. If memory and association were the only signs of intelligence this scheme for the classification of the psychic faculties would be complete though very general. To say the least the scheme is ingenious and deserves serious consideration.

(4) *Free observation of animals in captivity.* This method was employed by Cuvier, Romanes and Garner in their studies of monkeys. Probably no other method suffers so great limitations. The caged animal often ceases to be himself. He varies from insipid tameness and moroseness to wild excitement, and is in several ways very different from what he is in his larger freedom. The method is in reality but an application of the first method described above to a single case of the one yet to be described. It is a free observation of an animal's reaction to a single kind of apparatus—the cage. Those employing the method, for the most part, have observed loosely and have interpreted rather liberally. The method is only semi-scientific, and the results that have been obtained have not always been very reliable. Such expressions as "A great many times," "A great many monkeys," etc., are too loose for scientific use. Studies on this plan have ascribed to the animals observed all sorts of capacities. In addition to loose observation, Mr. Romanes has unfortunately given credence to many stories by hunters and other untrained persons where the details of the stories were wholly omitted. Very often when one has the full situation the wonderful achievements of the animal drop to the level of the common-place. The reader will find such an illustration in my report of the monkey's reaction to the trees, given in the next section. Besides the fact of imperfect observation the ordinary observer is prompted by an inordinate desire to exalt the powers of his "pet dog Solomon," and make him appear as wonderful as possible. But when put to careful test the wisdom of "Solomon" is often found to fall below the level of that of the ordinary cur. Among the students who have ascribed undue value to these current stories of animal intelligence, the most prominent are Houzeau, Lind-

say, Romanes and Weir. The great Darwin himself has not wholly escaped this tendency.

We would commend this method as a partial one, but like other methods, it needs the checks and control tests of other methods to keep it in the straight and narrow way. I count it a poor method but one by no means to be wholly abandoned.

(5) *Experimental.* This method consists essentially in subjecting the animal to fixed or controllable conditions, and in noting its qualitative and quantitative reactions. Lloyd Morgan, Kline, Small, Thorndike, and others, as is well known, have employed this method somewhat extensively. By way of example, it may be well to present here Thorndike's explanation of the method, when dogs and cats were the subjects.

"By this method of experimentation the animals are put in situations which call into activity their mental functions and permit them to be carefully observed. One may, by following it, observe personally more intelligent acts than are included in any anecdotal collection. And this actual vision of animals in the act of using their minds is far more fruitful than any amount of histories of what animals have done without the history of how they did it. But besides offering this opportunity for purposeful and systematic observation, our method is valuable because it frees the animal from any influence of the observer. The animal's behavior is independent of any factors save its own hunger, the mechanism of the box it is in, the food outside, and such general matters as fatigue, indisposition, etc. Therefore the work done by one investigator may be repeated and verified or modified by another. No personal factor is present save in the observation and interpretation. Again, our method gives some very important results which are quite uninfluenced by any personal factor in any way. The curves showing the progress of the formation of associations, which are obtained from the records of the times taken by the animals in successive trials, are facts which can be obtained by any observer who can tell time. They are absolute, and whatever can be deduced from them is sure. So also the question of whether an animal does or does not form a certain association requires for an answer no higher qualification in the observer than a pair of eyes. The literature of animal psychology shows so uniformly and often so sadly the influence of the personal equation that any method which can partially eliminate it deserves a trial."

If the trials are continued for some time one has a large element of training, and the method comes to have a great deal in common with method four. With this method is afforded opportunity to study association, memory, imagination the senses, powers of generalization and reasoning, besides individual differences and educability. We get here, as in the method of training, not so much what the animal *does do* in his native environment as what he is *capable of doing* under somewhat artificial conditions. It alone can furnish opportunity for anything like exact quantitative work, while it possesses all the advantages of training so far as repetitions and critical observations are concerned. Its limitation is to be found chiefly in this, that it loses the native activities of the animals and does not use the signs ordinarily employed in training by persuasion without the stimulus of food.

One of the great difficulties in the employment of this method is that of selecting tests and apparatus properly related to the character of the animal studied. Taking only such activities as are wholly natural to the animal, and such apparatus as is easiest for him to operate, makes his reactions very simple, and the test fails to bring out his possibilities. On the other hand, the tests selected must not be too far removed from the field of his natural activity, for in such cases the animal is often completely baffled, and only the most limited results are obtainable. The animal may appear stupid because the test is unsuitable, and thus be easily misjudged.

The highest possible knowledge of an animal is hardly to be reached by the employment of any one of these methods. The methods are not equally applicable to all animals. Yet there is every reason for believing that if all are employed upon the same animal, as far as possible, we shall arrive at a more complete understanding of him. Not opposition to one method or undue emphasis upon another, but a reasonable use of each within the just limits of its applicability, should be the practice of the student of comparative psychology.

Methods of Interpreting Data.

Wundt sets forth two points of view in animal psychology.[1] "We may set out from the notion of a kind of comparative physiology of mind, a universal history of the development of the mental life in the organic world. Then the observation of animals is the more important matter; man is only considered as one, though of course the highest, of the developmental stages to be examined. Or we may make human psychology the principal object of investigation. Then the expression of mental life in animals will be taken into account only so far as they throw light upon the evolution of consciousness in man." Wundt pursues the second of these courses, and insists that "not the least advance can be made, either in the psychology of a particular animal or in that of the animal kingdom without starting out from the facts of the human consciousness." In spite of all the warnings against reading our own powers and processes into the lower animals, when we undertake to study their psychic phenomena, I am not certain but that that very thing is necessary, within limits, in all fruitful studies of the mental life of animals. But the careful student of human and animal minds will avoid prematurely concluding that because he finds the mental factors and processes thus and so in one of these great fields of investigation, they necessarily obtain in the other in the same relation. The schematized evolutional life of animals possibly applies to man. But direct and unhesitating application should be questioned.

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[1] Human and Animal Psychology, p. 340.

Again, the camp of comparative psychologists divides on the application of the *Lex parsimoniae* in the interpretation of their data. There can be no doubt but that the application of the law is a virtue and its rejection a vice. In practice, there are on the one hand extremists who ascribe to animals, with an almost pitiful blindness, and without limit, all sorts of human and angelic powers; on the other hand, there are other extremists who reduce every mental process of the animal to a common level in lowest terms—tropisms, instincts and associations. The former are virtually vicious and the latter are victims of their virtue. In the one camp we find steeped more or less in the vice, Romanes, Weir, Garner, and Mills; in the other, Wundt, Morgan, Thorndike and Loeb.

As in many other cases, the true practice is in all probability to be found between that of the extremists. My sympathies lie nearer to the "victims of the virtue;" nevertheless, it seems to me that we must not concede that the mental processes of the animal are so unlike human processes as to be absolutely simple.

If in any class of animals one can be shown to imitate, remember, invent or reason, then a complex reaction of any one of the class cannot safely be explained without reference to this possible process as a part of the complex. Over-simplicity is the rock of danger to the over-parsimonious.

GENERAL OBSERVATIONS.

My first monkey, a male *Macacus rhesus*, arrived Oct. 15. The female came about one month later. The male was said to be about eight months old, and the female, twelve. Jack is more nervous than his mate, Jill. His nervous mechanism is set off by little noises and threatenings which pass entirely unnoticed by Jill. Shipping had greatly frightened him. He sprang about the cage, threatening, and uttering a loud call by ones, twos, threes and fours. This call or scream is hard to represent by letters or the human voice, but it is approached by *hwuich*. It appeared to be prompted by a feeling of loneliness, lostness, strangeness and hunger, and to be given as a call to learn the whereabouts of others of his kind. As a caged animal, his social instincts do not appear to be very highly developed, though in its natural habitat the species plays and goes foraging in bands. The calls were most vigorous on the first and second days and almost wholly disappeared in about a week. While experimenting he has given the call a few times with apparently no other stimulus than hunger. The frequency of these calls can be judged from two ten-minute records: Oct. 17, 21 times; Oct. 18, 18 times.

JILL. JACK.

When a live frog was thrown into the cage, he grabbed it but let it go immediately and sprang to his perch. He appeared to be taken by surprise, and was not really afraid of it, for he returned immediately, caught it up and pulled it to pieces using both hands and teeth in the process. He did not appear to do it as if destroying an enemy, but as a mere feelingless business matter, as if it were something that ought to be done and he did it. If he had any feeling about it, it did not betray itself. His face, like that of a baboon, for indeed he is very baboon-like, is almost totally expressionless. To me, it has as yet but two forms: one with the mouth closed and one with the mouth opened. The latter occurs when he crouches and threatens or tries to bluff one, and when he sees food and apparently thinks how good it would taste. I believe that much of the monkey's expressions of triumph, villainy, jealousy, anger and risibility are either in the manner and speed of limb and body movement, or in the viscera of the observers who read into them a feeling like that which they suppose they would have under similar circumstances.

These monkeys show fright by hasty springs in the cage, or by running and looking back when loose in the large room. When baffled in an attempt to open a box for food Jack walked away uttering a mild audible sigh, *hweuwh*. Surprise is shown by a quick jerk of the body; anger, on the part of the male, at the collar, by quick jerky efforts to bite or tear it, and curiosity, by gentle peeps and lifting an object up with extended hand. He did this with a rattle box put into the cage; and, again with a paper sack containing a small snake, of which he was afraid, yet, curiosity led even to tearing a peep-hole in the bottom of the sack, through which, with much caution, he often looked at his hereditary enemy.

The gnawing, which was considerable at first and continues to some extent, appears to be prompted by the instinct of escape, and leads him to lay hold wherever there is good gnawing. Some of the gnawing was done about the door. I think it is safe to assume that if gnawing at any point had brought release, gnawing afterwards would have appeared to be much more purposive.

They have shown no signs of play in any way. They take life seriously. When I first saw Jack springing up and down on the pan in the bottom of the cage I was half inclined to take it as a play manifestation. But he afterwards did the same thing on the top of a box into which he was failing to make his way. It appeared to be a sort of useless effort at just doing anything to get into the box or get out of the cage.

When a newt, which looks something like a snake, was put into the cage the monkey showed no fear of it. He did not tear it to pieces, as he did the frog, but rolled it between his palms many times, and at last bit it through the head and threw it down.

Jack and a pigeon were equally frightened at each other when in the cage together. Yet at times he would swing down from the wire or perch as if to touch or grab it, but at the same time revealed his fear of it.

A full grown cat brought into the room showed no fear of the monkeys whatever, but they were desperately afraid of it. They produced the "*nqu-u-w*" sounds in profusion, sprang into the windows, and sought the farthest corners of the room, even engaging in a mutual spat for vantage places of safety. On the following day when they were turned out of their cages they climbed into the windows and looked about everywhere for the cat.

I had been told that Dr. Thorndike kept his monkeys from touching things by putting a ball of cotton batting on them. Accordingly I covered a pear almost completely with cotton, pinning it fast with pieces of toothpicks and pulling the cotton out in a fluffy ball. I threw it into the cage. Showing no sign of fear whatever, he tore away the cotton with hands and teeth, and ate and pulled alternately until the pear was completely eaten.

On Oct. 20, I tied a rope to the end of Jack's little chain, and fastened the rope to a large post in the center of the room. After many accidents I succeeded in getting him properly tethered. He ran across his circular area of action receiving many jerks. But he profited by this and learned, except when scared, to avoid the jerking by carrying a foot of slack in his chain as he ran about or walked erect. He often paced thus along an arc of his circle until some twenty feet from his cage when he turned and ran back erect. But being frightened he broke the hook at the collar and gained his larger freedom. This freedom he has retained. When I waved a stick toward him he ran back to the cage. When the door of the cage is opened he usually goes in at once of his own accord. At a motion of my hand or at my calling "Get down, Jack," he gets down from a case or out of a window, especially if he sees that I am certain to approach if he does not do it. If I pretend to be at work and order him down in an ordinary tone of voice, without changing emphasis or inflection, he pays no attention. The monkeys have given no sign that they know their names.

The sounds produced by the male are the loud *hwuich* and the softer, *hweuwh*, an expulsion of breath through mouth and nostrils, a blowing of air out between the loosely held lips, and a grinding or a gritting of the teeth. These last seem to have no well defined purpose. All my efforts to reproduce these vocalizations have utterly failed to call out any response from them. The nostril and mouth expulsion I presume is the one represented by Mr. Garner by the formula, *nqu-u-w*. It is uttered most frequently when food is displayed and while eating, but may accompany disturbance by the keeper or by visitors. The sounds of the female are a loud call, corresponding to the male's *hwuich*, resembling the call of the woodpecker; a softer sound closely resembling the mew of a cat; the *nqu-u-w;* blowing between the loosely held lips; a baboon-like growl uttered when I kicked violently at her as if to strike her, and a high pitched screech.

In the early part of their larger freedom they spent much time sitting in the windows. They appeared interested in the street cars and wagons that passed along the street at the other side of the campus and enjoyed the warm sunshine. Later, I cut and set up three small trees in the room. They showed no interest in the trees until they began to bear bits of fruit and bread. Here their instinctive skill and ingenuity in getting food from the most inaccessible tips of branches was of especial interest. They seemed to scan the limbs and plan long before reaching the limb where food had been placed, whether to bend the limb around to a stronger one or to follow it to the end and drop to the floor or swing back to the limb and pass down the trunk. When food was placed on a strong limb that extended several feet to one side and pressed against the ceiling, Jack climbed part way up, then backed out and went to an adjoining limb where he seemed to examine the situation in order to determine the best line of attack. After examining from two places he went up the limb to a part near the ceiling then swung under and went hand over hand until the food was reached. He grabbed the fruit, let go with his hands and crammed the food into his cheek pouches while hanging by his feet, head downward. This operation completed he returned to the floor. At one time food was put on the end of a stick which was fastened to a gas jet. The stick projected horizontally out toward the middle of the room. The food was so high that the monkey could not spring up to it. One of the trees stood near. He ascended a long slender limb fully five feet away from the apple. His weight bent the limb down to the apple and he won the prize. The over-zealous for reasoning in animals can here be sure that the monkey showed a comprehension of a mathematical principle and of the law of gravity. But such was not the case. He sat at the farther end of the room while the food was being arranged. From his position it would be difficult to tell just how far it was from the limb to the apple. Besides this the monkey had been fed often from the end of this limb. Seeing food arranged near there he merely followed the old track, and as he did so found himself gradually coming nearer and nearer to the goal. There was no reason about it, and certainly no comprehension of mathematical and physical principles.

After a few weeks the trees were used considerably as perches to which the monkeys often retreated between tests, especially if the rearranging of the apparatus required some time. The window perches have come to be used only occasionally.

When food was shown the male it will be remembered that he dropped his chin and opened his mouth. Under the same provocation the female worked her lips rapidly. Some interpret this as a sign of anger, bluff or assault. Mr. Garner thinks that it may be "intended as a vote of thanks." In my opinion the *rhesus* never gives thanks for anything. He is not of the thankful sort. Nor yet does it express anger. It seems to me to be a kind of impatient nervous overflow intermingled with a notion of the taste and the eating activities to follow, while waiting for the food finally to be put where it can be reached, and is stimulated immediately by the sight of the food itself. The child represents the same physical excess by movements of the head, arms and legs, while he cries, "One for the money, two for the show, three to make ready and four to go." Jill has spent more time in the trees and less in the windows than Jack, shows less fright and is generally slower in all of her movements. No snakes, frogs or pigeons have been put into her cage.

The two have shown no spirit of play either separately or when together. A wheel like that used by squirrels was arranged, but it was never used except to secure food, and as a vantage point for seeing what was going on.

When out in the room, if food is thrown to them, both rush for it, but when either gets it the other respects the right of possession.

Sign language is used and understood somewhat. I have already spoken of the recognition of signs when delivered by the keeper. Twice the female struck with her hand when she thought the male was too near her food. If either is master it is she. When together, their favorite pastime is "flea hunting" which is really dust and dandruff hunting. Backing up in front of the mate, lying down or assuming a sort of pose is understood to mean "pick me." However, this sign language, if indeed it can in any sense be regarded as such, is only of the most rudimentary sort.

In general I may say that so far as I can learn, their reactions are in many ways like those of their wild state, and they show the same kind of ingenuity in meeting and solving their problems, in procuring food, in escaping from an enemy, and in finding their associates.

Repetition of Dr. Thorndike's Experiments.

Relation to Dr. Thorndike's Work.

Dr. Thorndike experimented with two *Cebus* monkeys from South America. He used a great variety of apparatus, consisting largely of designs with which food was associated, and of boxes having doors fastened with various kinds of latches. In these were placed food which the monkeys could get by moving the button or other device holding the door shut. I began my work by repeating, in the main, the experiments which he made. I have used in all thirteen kinds of fastenings for the doors of the boxes. Nine of these were afterwards put into second positions on the doors. Besides this seven groups of these fastenings were used. Three string devices also and a windlass were used in connection with the cage. Opportunity was afforded for but few experiments on imitation, and none by putting the animal through a process to be learned, since this species of monkey, like most wild animals, objects to being touched or handled, unless one begins with them when they are very young. While they have crowded by me for food or pulled my hands open for it, I have yet for the first time to touch them actively. The memory tests have been made with apparatus not used by Dr. Thorndike, so I reserve a discussion of them for another part of the paper. Only a few pieces of my apparatus are identical with Dr. Thorndike's, but the general character of them is the same.

General Conditions.

Those who have seen monkeys in captivity and in their native habitats have noted in some of them great differences under the two conditions. The caged gorilla is sullen; the female chimpanzee is often morose and sits about in a drooping position or engages in swinging the body to and fro. I have seen the golden baboon, when not entertained, indulge in a swaying of the body which was a cross between a swing and a vertical movement. Most monkeys, if they age in captivity, become crabbed and treacherous, however affectionate when young. I am not aware just to what extent the *rhesus* shares in this change of character but it is certain that his ill disposition does not disappear.

It is safe to assume that all studies of animals in cages and pens would show variations from those of animals in their native haunts. Such studies with the *rhesus* are less unnatural than with South American monkeys, for example, since owing to the peculiar attitude of the natives of India toward monkeys, they have become bold enough to take up their abode quite in the seats of civilization. At home they are in a degree reverenced. They may be chased from fields, gardens and orchards, and may be shipped by steam car or caravan into distant regions, or trained and sold for a foreign market, but they must not be killed. These monkeys enter the villages in troops to beg and steal food at the stores. They are acquainted therefore with man and his ways and works, buildings, streets, etc. Hence, a rather free captivity such as this pair has had (they were loose in a very large room), does not subject them to a wholly new environment.

In experimenting, the monkeys were kept hungry enough to make them keen in their efforts to procure food. It can hardly be maintained that they were subjected by this to unusual conditions, since in their wild state, it is no uncommon thing for them to become ravenously hungry. Starvation is always a menace and a not very remote possibility to all wild animals.

It has been urged that the tests to which monkeys as well as other animals are subjected by our fifth method, described in a previous section, are foreign to their apperceptive stock of ideas: that such experimenting is somewhat like asking a biologist or anthropologist to solve a difficult problem in higher mathematics, and by it the animals are put at a great disadvantage. They may appear to lack mental capacities, it is contended, simply because the tests employed are outside of their normal experiences and instincts. The criticism, so far as the Bhunder monkey is concerned, is only partly just. In his woody home he is engaged much of his time in searching for food. He must meet various situations in order to get fruit from the tips of slender limbs. Bark must be pulled away to get a fallen nut or to catch an insect. Fallen limbs and sticks must be removed in order to procure a nut or a root. These acts are not entirely unlike moving a bolt, button or hook, or pulling a string or plug. If these are new to him and he manages to operate them, then the whole matter becomes highly favorable to the mental capacity of the monkey.

Just how much these limitations have affected the natural reactions of the monkeys it is quite impossible to determine. It is safe to say that such tests as have been made do not give an unduly favorable view of their capacities. In any event I present here the results obtained under the conditions described, however favorable or unfavorable they may have been.

Apparatus.

The food was put into a box 11x13x15 in., having a door 6x8 in. in the middle of one side of it, and having hinges below so that the door opened outward and downward. A spring set on the inside of the door caused it to fly open as soon as released.

(The numbers on the cut, p. 112, correspond to the numbers of the fastenings described below. Only a part of the fastenings are shown.)

A. *Simple fastenings.* 1. A thumb-button extending in front of the upper right-hand corner of the door. It must be turned upwards or downwards about thirty degrees to release the door.

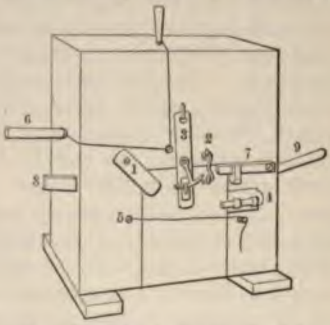
2. A small hook fastened to the box above the upper right-hand corner of the door and hooking into a staple below. This will be referred to as the vertical hook.

3. The T-latch. It was a thin plate of iron fastened by a staple above the middle of the door. By means of a slot in the

lower end of the plate it could be hooked over a staple through which was passed one end of a small T attached to the plate. The T came in from the right.

4. Bolt. This was an ordinary door-bolt. Pushing the bolt back allowed the door to open.

5. String. The string was fastened to a short screw to the left of the door, and wound eight times around a nail at the right. The door could be opened by unwinding the string.



6. Plug. A string fastened to the inside of the door passed upward an inch and thence through a hole in the front of the box, and around to the end where it was fastened to a plug. The plug was stuck into a hole in the box. The plug being pulled out, released the string and the door flew open.

7. Lift-latch. A bar having one end fastened to the box by means of a screw extended behind a cleat near the door, while the other end extended over the upper right-hand corner of the door. Raising the end of the bar next to the door two inches released the door.

8. The push-bar. A bar two inches wide and one-half inch thick passed into the end of the box just back of the boards on the front side and extended clear across just behind the upper part of the door. The cleat of (7) was put on the inside of the door and a notch corresponding to it cut in the underneath side of the pusher. By closing the door and drawing the pusher back three-quarters of an inch the door was held fast. When the pusher was thrust back into the box the end of the cleat passed through the notch and the door flew open.

9. Bear-down latch. It was arranged like the pusher except that it had to be pushed downward about two inches to effect a release.

10. String and bolt. A common door bolt at the top of the door and on the inside of the box could be raised by pulling a string at the rear of the box.

11. String and ring. This was the same as five except that

instead of winding the string around the nail a ring hooked over it.

12. Horizontal hook. It was the same as the vertical hook except that it held the horizontal position.

13. Lock and key. The lock was the ordinary door lock. It was placed on the inside of the box. The spring was removed from it that it might require only a minimum of force to turn the key.

B. *Chute-apparatus.* This consisted of a chute five feet long and inclined at about fifty degrees. At the upper end there was a pivoted tilting-board which being tilted allowed a morsel of food to slide down the chute. The wire front of the cage was brought near the lower end of the chute.

14. A string extended from the lower part of the tilting-board into the lower part of the cage, ending in a toggle that kept the end of the string within the cage. By pulling the string, food could be started down the chute. The monkey could reach out from the cage and get it.

15. The string passed from the tilting-board over a pulley 12 inches above the rear part of the top of the cage. The end of the string then passed down through a hole into the cage. By going to the back part of the cage and pulling the string the tilting-board was tipped and the food could be procured as in 14.

16. The string passed down from the tilting-board to the axle of a windlass. The handle of the windlass was in easy reach from the cage. By turning one and one-half times around the board was tilted, and food obtained as before.

C. 17. A string four feet long was tied at one end to a flat paper box. The other end was fastened to a toggle inside of the lower front part of the cage. By pulling the string in food could be procured.

D. 18. Imitation test. The lock and key. Problem—to put the key into the lock, turn it and procure food.

E. *Second positions.* When any suitable form of fastening was first used on one side of the door it was afterwards changed to the other side. These need only to be named as they have already been described in their first positions. They are: 19. Button. 20. Vertical hook. 21. T-latch. 22. Bolt. 23. String and nail. 24. Plug. 25. Lift-latch. 26. Push-bar. 27. Bear-down latch.

F. *Groups of fastenings.* Again these have been described individually and need but to be named. These might be released in any order. 28. Two buttons. 29. Two bolts. 30. Button and bolt. 31. Two buttons and one bolt. 32. Two buttons and two bolts. 33. Two plugs. 34. Three plugs, one being on the top of the box, two buttons and two bolts.

G. *Designs*. The apparatus consisted of two tin cans, each 2x1-2x2 1-2x3 inches. They were covered inside and outside with white paper, and so arranged that a marking card could be slipped in close to one side, leaving its top extending about three inches above the top of the can. On the side of the card facing the top of the box designs were drawn. The problem was to associate food with the box bearing the design.

35. The card on one box had four heavy, black horizontal lines, each one-eighth of an inch wide, two inches long and separated by blank spaces each one-fourth of an inch wide. The other card was blank.

36. A diamond one inch long and three-fourths of an inch wide on one card, the other blank.

37. A box like the one used with the fastenings, but with the back removed. This was placed with the door facing and near the front of the cage. The door of the small box was fastened with the thumb-button. Two large pieces of cardboard, one having a black paper 4x4 inches on the middle of one side were used as signs. In experimenting, providing food was placed behind the door of the small box, the card with the black square was held before the door of that box, between it and the cage, until well seen. It was then moved and the monkey was allowed, if he desired to do so, to move the button and take the food. When no food was placed there, a blank card was used in the same way. A table for the order of feeding was made out previously. The problem was to see whether the monkey would learn to open the door when the card with the black spot was shown, and not to do so when the plain card was shown.

Method of Work.

In experimenting, except with the string and windlass devices, the monkey was allowed the freedom of the large room. When a series of tests were to be made a few grains of rice or a small morsel of bread, banana or apple was put into the box and the door closed and fastened. The monkey was allowed to see this operation, but was never allowed to see me open the door except for an imitation test. By giving quite small baits the experimenting could continue indefinitely without producing satiety. When he lagged in his work or was inclined to sit in the window or to give the fastening up as beyond a monkey's ken, he could be spurred by showing a banana and tapping it against the door of the box, especially if by sleight of hand it was made to disappear from view at that point. Sometimes he was spurred by showing him the morsel in the box, and again by showing him a whole pile of food in the box. He would apparently work harder for much than for little, quite as if he had his price.

A cumulative stop-watch was used, and account was taken only of the time actually spent in trying to open the box. Time was counted no matter whether the monkey was before or behind the box, whether prancing around it or jumping up and down on top of it, so long as he was trying to open it. Some of these efforts were in no wise directed toward the latch. At first he did not appear even to suspect that the latch was a proper point of attack. But this prancing, etc., was, doubtless, effort to him. Much time was spent in shaking the box when the lock was a difficult one. For this reason the box was nailed fast to the floor.

The male only was taken regularly through these tests. The female gave up so quickly and completely with each new fastening, that to get her to move the bar, lock or button it was necessary to half conceal rice about it so that in the effort to procure the food the lock would be moved. Having repeated this several times she would come to associate the moving of the fastening with the opening of the door. Her time results, therefore, are not to be compared with his. Her work with the locks will be described from time to time under appropriate headings.

Only one fastening was given up by the male. That was the horizontal hook when first presented. He had four hours at his command, and spent seventeen minutes in prancing, shaking, gnawing and jumping up and down. This was the first thing presented to him. We shall revert to it later for a further discussion.

After the above each lock and group of locks was presented and he was allowed to work until the door was opened whether this time was long or short. When the door was opened and the morsel of food eaten, the trap was set again, and so on for thirty times, the seconds required for opening the door each time being recorded.

Results.

The following table and curves indicate the quantitative results of the tests with the male.

This table shows the times in seconds required for working the different fastenings including also the chute, and string and box (apparatus 17) tests. The figures designate the number of seconds used in working the device for each one of the thirty times.

The variations in the times for the fastenings are very great. While on the average the second effort required one-fourth as much time as the first, the T-latch required only 1-462. Again it required nearly twice as long to draw the plug the second time as it did the first time. It is plain that the button, bolt, bear-

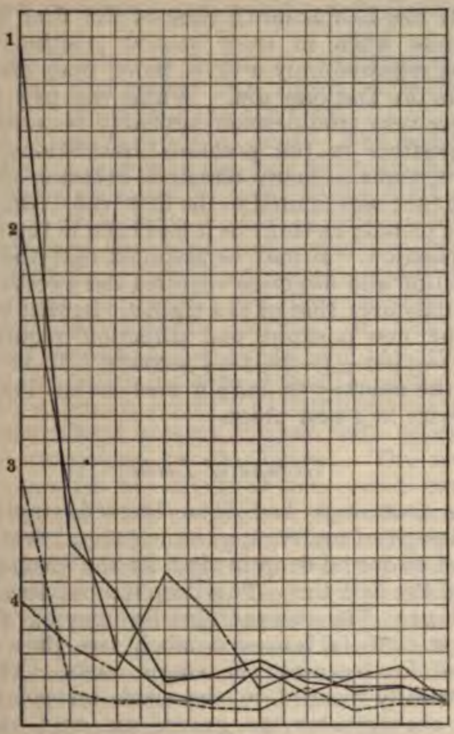
Button	10	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	[illegible]
Vert. Hook	65	63	3	10	2	40	30	40	67	10	1	25	1	1	59	3	3	9	3	1	20	24	1	1	1	1	1	1	1	2
T-Latch	462	1	1	8	6	52	5	31	1	6	2	12	13	1	3	3	8	3	1	2	4	1	1	2	1	1	1	4	4	4
Bolt	1	5	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	2	1	1
String & Nail	80	5	3	6	7	7	6	7	12	6	4	9	3	75	36	76	7	8	9	29	28	7	12	14	30	14	23	27	8	8
Plug	125	266	114	30	14	2	3	1	13	2	3	1	1	5	5	2	3	2	5	3	3	3	1	1	1	1	1	1	1	1
Lift-Latch	15	81	12	4	5	3	2	7	7	7	2	2	3	5	2	2	2	4	2	2	1	5	2	9	1	3	2	1	1	3
Push-Bar	168	5	1	3	4	1	3	6	2	1	4	1	1	7	1	9	2	1	1	1	1	1	1	1	2	1	1	1	1	1
Bear-Down	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	2	1
Rear-String	46	6	1	4	3	2	3	1	1	1	1	1	1	1	1	1	2	3	1	5	3	1	3	1	3	1	1	1	1	1
Ring & Nail	235	15	22	9	7	14	47	8	5	7	3	7	1	5	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1
String-Box	95	57	4	5	4	7	6	5	5	7	3	3	4	5	6	5	4	10	7	6	4	4	5	5	3	4	6	4	3	4
Hor. Hook	32	4	9	2	2	1	1	1	3	2	1	1	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Chute Str. below	3	3	2	2	5	3	6	1	3	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Chute Str. back	366	6	218	18	4	79	7	2	3	1	10	1	1	5	2	1	2	2	2	4	1	1	1	1	2	2	1	1	1	1
Windlass	672	127	21	16	6	5	12	10	4	9	10	3	4	2	2	14	2	9	2	2	2	8	7	9	15	3	3	3	7	6
Lock & Key	100	9	54	32	104	5	6	3	3	3	3	9	1	1	8	1	2	1	2	2	1	1	1	1	2	1	1	1	1	1
Aver.	[illegible]	38.5	27.5	9	10.3	13.2	8.5	7.4	7.7	3.9	3.1	4.6	2.5	6.9	7.7	7.2	2.5	3.5	2.4	3.7	4.4	3.5	2.5	2.6	4.1	2.8	2.9	3.1	2.1	2.2

down latch and chute with string below, were the easiest for him. Some, as the vertical hook and T-latch, were hard to learn, but easy to manipulate when once learned. Others, as the string-nail, string-box and windlass were difficult to learn, and were of a type that required considerable time for manipulation even though well learned.

The results of the first ten tests with all the different fastenings are shown in Curve 1. The seconds are shown on the ordinate by half millimeters. This curve is not, of course, a final representation of the general curve of learning by trial, as it is based upon only seventeen cases (seventeen kinds of locks). However it corresponds well with the curves found by others, and is doubtless of the same general character as one that might be obtained from several hundred cases with the same apparatus. One sees here the rapid decrease of time at the first. The minimum of time is practically reached at the tenth trial, as the table shows. With the individual locks there were considerable relapses at times after the tenth trial. The average time, however, soon becomes measurably regular. The frequent record of single seconds in the table are to be understood as indicating that the animal went to the fastening and released it, with his characteristic speed, with a single movement. The time was often less than one second.

Second Positions of the Locks.

Nine of these locks were put on the door in first and second positions, that is, on the right and left sides of it. The averages of the times required for moving the fastenings, when in



first positions, are given here in the upper line of figures. The averages for the second positions appear in the lower line.

114.1	47.5	15.2	7.2	4.6	12	6.2	10.5	11.7	3.9	2.1
52	7.4	4.8	5.8	4.5	3.2	7.4	2.5	3.8	4.2	3.4
5.7	2.7	10.7	12.1	19.9	3.1	3.2	2.7	4.5	6.6	4.5
2.5	6.3	6.3	6.4	2.8	3.3	2.5	6.1	3.8	2.4	1.7
2.4	2.7	4.3	2.7	3.5	4.3	2.2	2.3	(See Curve 2).		
1.9	3.2	3.1	3.5	4.0	3.5	2.1	1.7	(See Curve 3).		

Curves 2 and 3 show respectively the relative times for working these nine fastenings (see apparatus 19-27) in the first and second positions for the first ten trials. On the average about one-half as much time was consumed for second positions as for first positions. Here the problem seems to have been to learn that the lock was in a new place and that it was necessary to work it in a direction opposite to that used in its former position. It is significant that on the average when these nine locks were in the first position the second manipulation required nearly one-half as much time as the first manipulation required; while when in their second positions the second manipulation required only a little more than one-seventh as much time as the first one did. While the new position and direction were very troublesome, probably because they stood in direct opposition to the previous associations, when these were once overcome so many remained common elements that their interference was limited to the first trial. After seven trials the time was usually as short as it had been in the thirtieth trial in the first position. It may be assumed that the learning of the new position and direction requires the excess time in the first seven trials over that of the eighth. In that case the mastering of the new position and direction required, roughly speaking, 50—5—2—3—2—1—5 seconds. It is clearly more difficult for the monkey to learn a new device than to master the same device in a new place.

Groups of Locks.

After the fastenings had been learned singly the seven groupings described under apparatus (28-34) were made. In these we find an initial drop in time for the second test of but two-thirds of the first time. This drop is much less than that for single openings. The average time for moving the group of locks the first time is, however, much less than the average time required for learning the single locks. The minimum time is practically reached in the sixth instead of the tenth trial. The averages for the groups are 25.5, 16.5, 11, 31.5, 12.9, 7.3, 11.1, 6.4, 7.4, 6, 9.6, 8.3, 10.6, 9.3, 4.4, 5.7, 6.3, 5.7, 3.7, 7.0, 7.9, 12.7, 6.4, 5.1, 7.4, 5.1, 9.4, 10.1, 5.1, 6.0.

Curve 4 shows these results graphically for the first ten tests. The great rise in the curve for the fourth trial was due to a confusion over the group of seven fastenings. In these cases the method of opening each part was already known; the problem was to get to all the parts and to know what ones had not yet been moved. The time could not be reduced so much as when single fastenings were used, since it was necessary for the monkey to go to different parts of the box in order to reach the several locks. When the group consisted of two or three fastenings the monkey soon adopted a regular routine which he rarely failed to follow.

Experiments with Designs.

Three hundred tests were made with apparatus 37. It was assumed that if the monkey learned to associate the card having the black center with the securing of food and the blank card with not securing food, he would turn the button when the former was presented, and would not do it when the latter was presented.

Although each card was presented 150 times no association was formed and the button was moved each time without a moment's delay throughout the 300 tests.

Apparatus 35 was constructed next. The food was put into the box where the card bore the four horizontal bars. The two boxes were then set down in front of the monkey, about ten inches apart. After he took the food, a new morsel was slipped in, sometimes from one hand and sometimes from the other. The boxes were then picked up, passed behind my back and exchanged or not exchanged and then returned to the floor facing the new position of the animal. In these he chose the right box 154 times and the wrong one 146 times. Clearly there was no association of the food with this design. The tests were certainly extensive enough, as will be seen when we examine the results where glasses covered with paper of different shades were substituted for the boxes. The monkey failed most likely because his attention was never caught by the marks upon the card. The blank card on the box not having food placed in it, was cut away leaving a strip projecting upwards about three inches. The other box was surmounted with a large square card. Three hundred-eighty tests were made as before of which 242 were right and 138 wrong. Afterwards two vertical strips each about one inch wide and three inches long, one colored blue and the other green, were used with 38 right cases to 52 wrong ones. Glasses were now substituted for the boxes. One glass was covered with black paper and the other with white. Food was put in the one covered with black. The result was that he chose in the following order, + standing for right choice and — for wrong: + — + — + — — + + — +. Though many more presentations were made, there were no more wrong choices. Here we have the association fixed very readily when the apparatus was such as really appealed to the animal.

With the female 50 tests were made with the boxes. One of the cards was blank while the other bore a large black diamond. Thirty of the choices were wrong and only twenty right. But again when paper covered glasses were substituted we have: — + + — — + + + — — + — + + + + + + + + + +. There having been no errors in the last ten choices I considered the association perfected. With considerable justice, it can be inferred from the experiments with the covered glasses that the association with the preceding designs, if it was ever to have been formed, would have appeared with the opportunity given.

Comparison of the Results of the Present Experiments with those Obtained by Dr. Thorndike.

In these experiments, as in Dr. Thorndike's, there appeared no case that could be interpreted as reasoning in the higher senses of that term. When the box was set for the male the first time he went to it and pushed rapidly and violently right and left up and down around the door. Where the edge of the door projected a little beyond the level of the box it was both gnawed and clawed. After working there awhile he chased around the box and went at it again. Then the box was shaken and attacked again. The edges and corners of the box were jerked and gnawed. This was continued for seventy seconds, when he stopped and engaged in a short "flea-hunt." This was followed with alternate work and rest throughout a period of four hours, seventeen minutes having been used in actual effort. In all this time the horizontal hook had hardly so much as been discovered, and apparently there was no notion that it had anything to do with preventing the door from opening. The female tried this hook similarly, two months later, but could not be induced to do more than look at the box after 102 seconds of trial. After the male had entirely given up, the hook was removed and the button was then put on. He opened the box now in ten seconds, but the opening was a mere accident of the general scramble. However, the table will show that he profited by his fortunate accident. In moving it the second time he did not deliberately put his hand on the lock. He seemed to think that scrambling at about a certain place would get the door open, and so he scrambled there. After the eighth trial he put his hand every time directly on the latch and moved it. Throughout the experiments we find what Dr. Thorndike designated as "gradual learning by a gradual elimination of unsuccessful movements and a gradual reinforcement of the successful ones." In this way, however, effort came to be fairly well directed even on attacking a new lock.

Special movements with "directness (which reminds one unavoidably of human actions guided by ideas") appeared in the course of the monkey's efforts; for example, in the application of the teeth where the hands failed, and again in the substitution of hands for teeth where a fastener had been learned and moved several times previously with the teeth, but might be moved more readily with the hands. Dr. Thorndike noted substitutions of this kind with the *Cebus* monkeys. Some of the lower animals under similar circumstances never make substitutions but follow persistently the first accidental method and association. Presumably the animal which can make such a substitution has a psychic life superior to the one which cannot do it.

Methods of Learning.

(1) *Learning by trial.* I have already mentioned learning by trial more or less definitely directed, fortunate accidents, recollection of these acts, elimination of the useless efforts, substitution of more appropriate methods of accomplishing the end in view.

(2) *Learning by imitation.* Only one opportunity was made use of for getting an imitation of an act performed by the experimenter, and in that case it failed. After the door of the box had been opened as many as thirty times with the key so arranged that it could not be removed from the lock, it was removed and placed near the door. The monkey did not so much as seem to discover that the key was the object that he had just been using. It was picked up both with the hands and with the feet apparently as a mere accident. I then picked it up and opened the door with it fifty different times with the monkey only two feet away and looking on. There was absolutely no effort at imitation. Imitation of one animal by the other, however, was more successful. I tried on four consecutive days to teach the female to work apparatus (6). In order to get her food she had to pull a plug out of the end of the box. After 5½ minutes of trying she gave it up, hardly so much as discovering the plug. But she gnawed the string in two several times. Rice was then put into the hole around the plug, and even out on the plug itself. In the course of an hour I succeeded in this way in having the plug drawn seven times, but only once without rice. She seized the plug with her teeth near where it entered into the box. It was chewed and pulled right and left until it finally fell out. Except in one instance the drawing of the plug did not in the least seem to be associated with the opening of the door. On three other days the experiment was repeated without putting food on the plug. It was pulled right and left but was never drawn. Further, she became so thoroughly discouraged that she would walk away from the box without effort as soon as she saw that the plug was the mode of fastening, even though she had seen rice and other food put into it. At this juncture the male was turned out of his cage. He went immediately to the box, she following some four feet away. Knowing the trick perfectly he seized the end of the plug with his teeth and removed it. I set the box again. This time the female rushed to it, seized the plug by the end as the male did, and procured the food. This she repeated immediately eight times in exactly the same way. On succeeding

educability within narrow limits. If one accepts intellectual evolution he might expect, at least, as a possibility with the higher classes of animals, a small degree of general improvement.

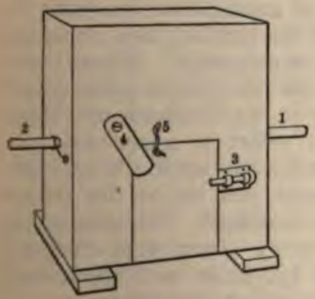
To sum up briefly this phase of my experimental work I find:

1. The monkeys have not reasoned in the higher sense of the term.
2. First efforts require much more time than later ones, the time shortening very quickly. There are frequent reverses after an association has been fairly well fixed.
3. The monkeys are capable of substituting a better for a poorer method of manipulation.
4. In dealing with groups of manipulations they adopt a regular order.
5. The main body of their learning has been by trial and happy accidents, the recollection of these and the elimination of useless efforts.
6. The female, however, has learned by imitation.
7. They have shown an increasing ability to pick out the fastenings as the essential point of difficulty in opening the box, and to direct their efforts upon them alone.

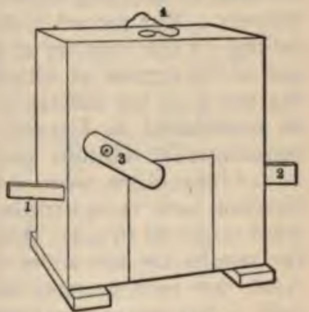
COMBINATION LOCKS.

The remainder of this paper is based on experiments which, so far as I am aware, have never before been made on monkeys. The first have to do with locks of a more complicated character.

Apparatus.



COMBINATION I.



COMBINATION II.

1. A box like that used in the previous experiments was again employed. The door was fastened by a vertical hook at the upper left-hand corner so arranged that a button near it had to be pushed back before the hook could be moved. But

The tables show both in times and errors a rather rapid reduction at first and a slower reduction later, along with numerous relapses. It will be noticed that on the second combination lock the twelfth group of 10 tests with the male shows a very great reduction both in time and errors, immediately followed by higher numbers and that this low standard was not reached again. At this twelfth group 7 out of 10 of the efforts were without error. I expected him to reach the standard in the next group, but at this juncture a distinguished friend and visitor came in for a few minutes. The animal took fright, and as it was very late, the experimenting was postponed to the following day with the result above. While the break prevented the monkey from accomplishing his feat it furnished a fine example of the effect of the fright and the fifteen hours' delay on the slow mastery of what was proving to be a very difficult task.

It will be seen that the female reached our arbitrary standard with the first lock in eighty tests. A further comparison of the processes of the male and female here as in the case of many of the other tests will be made later under the heading of "Individual Differences."

In working combination 1 the male went from the right plug by way of the front of the box to the left plug. In doing so he passed by the bolt and button, neither of which could be moved before the left plug was removed. In the earlier attempts he tried these fastenings as he passed by them, later he would raise his hand as if to put it on the bolt, and then as if remembering that it could do no good he would withdraw the hand without touching. This was repeated several times before he came to pass it by without notice.

The female went from the right plug around by way of the back of the box, but for a long time tried the bolt, using the left hand, before starting around. Here again came a course of ten or twelve cases in which the hand was extended part way and then as if to say "no, that does n't come next," she withdrew the hand and went on her way.

Twelve human adults and five children were tested with the same combination lock. Unfortunately no record was kept of the number of their errors. Later, two adults and two children were systematically tested with both combinations. The first and second times, given in seconds for the twelve adults were, 90-5, 45-4, 69-8, 13-3, 11-3, 57-7, 19-4, 300-6, 154-5, 132-7, 20-4 and 7-3. Correspondingly the times for the children were, 112-30, 216-21, 184-31, 65-13 and 45-7. The monkeys' first two times were, 78-33 and 64-65. The two adults tested ten times with combination 1 reduced their times respectively from 6 and 8 seconds to 1½ and 2 seconds. The children reduced their times respectively from 80 and 45 seconds to 2 and 2 seconds. The monkeys' show no material change from their first to their tenth trials. Read as above their times are, 78 and 54 for the first and 52 and 90 for their tenth trials. With the second combination the two adults changed from 11 and 36 to 2 and 4. The children changed from 105 and 20 to 6 and 3, while the monkeys changed from 139 and 187 to 110 and 26.

Allowing due range for individual differences it yet appears that the results obtained with the children resemble the results obtained with the monkeys more than do those obtained with adults. The essential method of learning these combinations on the part of human beings is just the same as on the part of the monkeys, that is, trial, the remembrance of accidental successes and the dropping away of superfluous efforts. The nature of the locks gives little opportunity for reasoning one's way to success.

When the human adult attacks the box he looks at it and attempts to reason about it. If he tries the wrong latch first he is slow about attacking it again. He usually tries to move a latch by the use of strength enough to break it. If urged not to break it, he stops and tries to reason again. When he gets one latch moved and takes hold of a wrong one next he is liable to return and try to replace the one already moved. But when once through he usually remembers the road to success and retraces it very rapidly. By the third time he has practically reached his highest speed.

The child tries immediately, and, like the adult, plays havoc with the apparatus if it is not equal to his strength. He holds on, where he tries first, for some seconds. Then he looks bewildered, tries something else as before, draws a long breath and looks helplessly to you for directions. Urged to go ahead he may try the same thing over. Finally he succeeds in moving one part. He stops and looks up, apparently with a feeling that it came too easy or as if he feared that he had broken the machine. Errors persist longer with him than with the adult, and his time is reduced more gradually.

But when the monkey attacks the box he does not stop to think about it. He tries one thing, then another and another in quick succession. One part worked he tries all the others, though he may labor on one at times, and try often to move parts that have already been moved. If he fails to move the first part of the combination he may go again and again over the second, third and fourth parts. As he does so he comes to make no real effort at any one of them. Each is given only a passing trial or a mere touch.

The short-circuiting process by which speed and skill are

This gave him opportunity to survey the vessels and make his selection. If set down too near him he would rush to the nearest vessel, making no choice whatever. A typical case would be like this: the monkey ten or fifteen feet away, "flea hunting," continues until he hears the board strike the floor, when he rolls up onto his feet and dog-trots over toward the board. The eyes are blinked toward the board as a whole or moved so as to sweep the entire length of it in the fraction of a second. At a distance of from six to ten feet it becomes apparent which vessel he means to try first. Occasionally, however, when the association has been established fairly well, he may come within two feet of the board in the direction of a wrong vessel, and then, as if noticing the mistake, make a rather sudden curve and go to the correct form. Until the association had been pretty thoroughly established the monkey inspected the other vessels after getting his morsel. But when the matter had been well learned he took the food and trotted away immediately. When he came up directly to the wrong vessel, he looked into it with hand up-lifted to take the food. Not finding it he looked into the vessel next to this one. This looking into the vessel was continued until the food was found. If food were in the vessel standing in position (1) at the left of the board for example, and he should come up to the one in position (2) he might go next to (1) or might pass along the six forms in the order, 2, 3, 4, 5, 6, 5, 4, 3, 2, 1. On the return movement (5) was looked into in the earlier experimenting, but later, the return would omit (5) and occasionally both (5) and (4). The tall cylindrical can appealed so little to the monkeys that they rarely went to it directly, but in case of a wrong start, if the can came in between the vessel first looked into and the vessel containing food, it was examined like the rest.

TABLES OF ASSOCIATION WITH FORMS.

(*Male.*)

FORMS USED.	FOOD IN RECT. BOX.			FOOD IN GLASS.						FOOD IN ELLIP. CAN			FOOD IN TRIANGULAR BOX.			
Triangular Box	6	3	1	1	2						4		3	11	26	25
Glass	1				11	19	26	29	30	16	5	1	5	3	1	1
Bottle					3	10	2			1			1			1
Tall Can							1			2						
Elliptical Can	4			1	4	1	1	1		10	21	29	15	9	1	2
Rectangular Box	19	27	29	28	10					1			6	7	2	1

(*Female.*)

FORMS.	FOOD IN RECT. BOX.		FOOD IN GLASS.			FOOD IN ELLIP. CAN.			FOOD IN TRIANGULAR BOX.		
Triangular Box	6	2	2						**7**	**10**	**25**
Glass	8		**2**	**22**	**28**	27	14	3	3	1	
Bottle	2	1		2		1					
Tall Can											
Elliptical Can							**7**	**26**	12	11	4
Rectangular Box	**14**	**27**	26	6	2	2	9	1	8	8	1

The results of the tests have been divided into groups of thirty each. The numbers in each of the vertical columns in the tables above indicate how often the animal went directly to the form in question in the thirty tests. No account is here taken of the forms looked into after the one to which the monkey went directly. Thus if the food was in the glass he may have first gone to the bottle and then to several other forms before going to the glass. In such cases these tables take account only of the look into the bottle.

The original notes were fuller, however. An attendant recorded the results for me. If the animal went directly to the box containing the food this was noted as a success. If, however, he went first to some other form, a note was made not only of the form approached first but also of what other forms were looked into before finally coming to the one containing the food.

The male was fed consecutively 90 times from the rectangular box; afterwards 180 from the glass; 90 from the elliptical can, and 120 from the triangular box. The female was fed from the rectangular box, glass, elliptical can and triangular box respectively, 60, 90, 90 and 90 times. Testing was always continued until the animal could make from 25 to 30 correct choices out of 30 trials. In some of the size and color tests to be mentioned later, when as many as 300 tests were made with no signs of improvement in the association, the experimenting was discontinued without this standard having been reached.

When the food was placed in the rectangular box which was the first form used, the association was practically perfect for both animals in 60 tests. With the male when the food was changed
'ass the table shows the old habit practically broken in
id 30 of trials and the new habit practically perfect in
h 30. The female perfected her association with the
When food was put into the elliptical can the old
roken up in the second 30 and the new was per-
third. In changing to the triangular box the
broken in the first 30 and new was formed in the

third. With the female the change from glass to elliptical can revived the first association so that the rectangular box was chosen 2, 9 and 1 times respectively in the three thirties. When the food was changed to the triangular box this first association was again strongly revived, the rectangular box being chosen 8, 8 and 1 times. A similar revival occurred with the male when the food was put into the triangular box.

Sometimes the changes or breaking of the previous associations were very sudden. In the table it will be seen that the male made 19 correct choices in the first 30 tests when the food was put into the rectangular box; and, again, 10 correct choices when the food was put into the elliptical can. These would appear less abrupt if the results were arranged in groups of 10 each instead of groups of 30 each. In the first of the cases just mentioned the male made no correct choices in the first 13 tests. In the second case 6 of the correct choices were made after the fifteenth test.

The superiority of human beings in breaking such an association may be seen in the fact that my assistant who helped to change the position of these forms and who put the food into the boxes, in all of the above changes, only once or twice threw the food into a box used in a previous series, while the monkeys returned to their former associations from 21 to 36 times. Their success in establishing associations with these forms was greater than with the sizes and colors tried later.

If one takes into account the total number of forms looked into by the monkeys instead of counting only the number of times that they went directly to the wrong one, as I have done in the preceding table, the errors appear to be a little more than three times as numerous. To illustrate, in the first 30 tests for the male as shown in the preceding table, when food was put into the rectangular box, he made 11 wrong first choices, but he looked 25 times into wrong boxes. When the food was put into the elliptical can, in the first 30 tests, while he made 20 errors by direct choice he looked 61 times into the wrong boxes. This method of counting errors, while suggestive, does not seem to me to be the best method of evaluating the reactions. If the food is in the glass and the monkey comes from a distance and goes directly to the bottle, he clearly makes a mistake. He has selected the wrong form and should be credited with one error. If the rectangular box stands next and he peeps into it this ought not to be counted an error since it is not a cho[illegible] The box [illegible] next and he goes to it for no [illegible] ext. This difference between [illegible] cely illustrated with the [illegible] rely ever chosen, as the [illegible] always looked into if a mistake was made and it came in the line of search. In all the tests following, in sizes, colors and numbers no accounts will be taken in the tables of this extra looking into vessels.

With the male when the food was put into the glass a confusion arose between it and the bottle. This is shown in the table by the 3, 10 and 2 times that the bottle was chosen. The fact that the two forms were somewhat alike will account sufficiently for the confusion.

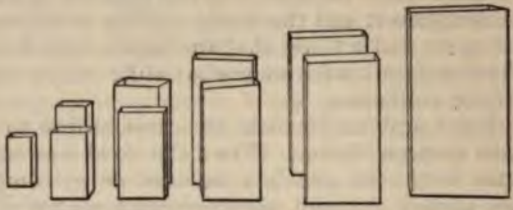
The monkey's problem in these tests was at first to associate the food with a special form. When the food was afterwards put into other forms the problem became more complex, and the monkey passed through three distinct stages in dealing with it: (1) a series of artless returns to the forms previously used, (2) a stage of confusion in which there was a conflict between the old association and a dim realization that the food was not to be found where it had been before. In this stage the monkey was about as liable to go to one of the six forms as to another. The duration of this period was not always long enough to show in a table made out by thirties. (3) A stage of progress toward perfection in the new association. The processes at this stage seem to follow the same order as where there were no preceding associations to be broken up.

That the animal's choice was not based upon the sense of smell but upon the visual recognition of the form was very apparent. With one exception, when the monkey was searching for food, the head was turned so as to bring the eye over the top of the vessel. In the course of several thousand tests of this general type the monkey only once seemed to try to locate the food by the sense of smell. All discussion of this question, however, is reserved for a section on "The Sense of Smell."

Summary. Restating briefly I may say that the monkeys are able to discriminate these forms and to associate food with them consecutively. The associations are not formed by a single trial, but come about more or less gradually through much repetition. It is easier to form an association *de novo* than to break an established one and form a new one. The necessity of forming a new association induces a revival of former associations of the same general kind. The learning process, upon the whole, is still that of trial, happy accident, recollection of the fortunate movements, and an elimination of the useless ones.

SIZE TESTS.

The tests for discrimination of sizes were made on the same general plan of those for forms. Instead of the boxes there used I made six rectangular paper boxes having an altitude twice one side of the base. Their heights were 2, 3, 4, 5, 6, and 7 inches respectively. In the cut, which was made from a photograph, these boxes are shown as the smallest and the largest



together with the four others in the rear. The first box was too small to be used for feeding and the last was rather tall. For this reason the monkeys were fed only from the four intermediate boxes. We shall speak of these size-boxes by the numbers 1 to 6 beginning with the smallest.

Although many more tests were made with the boxes of different *sizes* than with the *forms* the association never became so definite. The *forms* used in the preceding series must have been much more readily distinguished than are the *sizes* used here, for while the male made the four associations of *form* with 480 tests, 1,080 tests with the *sizes* sufficed only to induce a general grasp of about such and such sizes. The female was tested with only a part of these sizes, but with these she showed greater ability than the male though she made about the same confusions as he did.

In the form tests they had to associate their food with a particular geometrical figure and had only to look for that one particular thing. No other form needed any special attention. In trying to select the correct size, however, if the monkey was to succeed in choosing rightly, he must compare before he could be more than measurably sure of choosing correctly. Probably the only alternative to such a method was for him gradually to fix upon an absolute size and thus resolve his problem back toward that met in the form tests, though this would be by no means easy. It may be that this is what the female did and thus secured better results than the male did.

The blunders of the monkeys in these size tests are quite interesting in themselves. When the food was put into box 3, 3 and 4 were frequently confused; while 3 and 2 were confused much less frequently, even less often than 3 and 5. The same thing appears throughout the tests. When the food was in 5, 6 was chosen more frequently than 4, even when 4 was much nearer the size of the previous feeding form. This can sometimes be accounted for by the order of the tests. For example, when the food was changed to 2, after being in 3 and 5, on account of the previous association with these larger forms, 5 and 6 were chosen oftener than 1. But the tendency cannot always be explained in this way. When the food afterward went over to 4, 5 was chosen more frequently than 3; and 6 more frequently than 2. Why should the confusion be always with the larger forms? My first thought was of the psycho-physic law. While the altitudes of the boxes were 2, 3, 4, 5, 6 and 7 inches, the lateral surfaces presented to the monkeys as they approached were, 2, 4½, 8, 12½, 18, and 24½. Thus, while box 1 presented a surface less than ½ of box 2, box 3 was nearly ⅔ of 4; and 5, nearly ¾ of 6. The proportional difference constantly grows less and less. If volumes are considered, the variation is still greater. Then the ratio of box 2 to box 1 is much greater than that of box 4 to box 3, or the ratio of difference decreases as the larger boxes are compared, so that the stimuli for distinguishing boxes become less and less. This confusion of the larger forms would then be in harmony with the psycho-physic law of stimulus and sensation. The less the proportional difference the greater the confusion of forms. As a control test, I constructed a series of boxes varying in volume by the set ratio twenty-one tenths beginning with the first box as before, 1 x 1 x 2 inches. The other boxes like this one were made twice as high as wide. The sixth box was so nearly the same size as the sixth in the former tests that the old 6 was used again. The volumes of these boxes were:

Old series:	2	6.75	16.	31.25	54.	87.75
New series:	2	4.2	8.82	18.52	39.2	82.31

These forms are represented in the front row in the cut along with the largest and smallest boxes as before. It was assumed that if the monkeys selected according to the psycho-physic law in this matter they would confuse the feeding box each time equally with larger and smaller boxes. Here again, however, the confusion was with the larger forms. It may be that the tendency was to choose the larger forms simply because they were more conspicuous. Possibly, in monkey logic, it may appear that the larger forms should bear the most fruit; so that by choosing a larger form more food would be obtained, and that desiring to run no risk of missing food they went to the larger boxes.

Summary. These tests reveal what seems to be an ability either to compare sizes roughly or to fix upon an absolute standard of size. If one recalls the experience with the designs it will not seem probable that this association was based on any accidental markings or other minor peculiarities of the boxes. Their choice does not seem to have been made in any perceptible degree according to the psycho-physic law. Besides these this study reveals nothing not already shown in the experiments with the *form tests*.

DISCRIMINATIONS OF COLOR AND SHADE.

The presence everywhere in the animal kingdom of colors, ranging from the most modest to the most brilliant, protective coloration in animals, and the display of colors in animal courtship, would suggest, at least, the possibility that animals not only perceive colors but have preferences among them.

But, except for insects, very little has yet been done to give experimental proof of color perception, and almost nothing to show that the apparent cases of color perception and preference are not based upon discrimination of light and shade rather than genuine color perception. If, for example, an animal shows a preference for a light yellow over a dark blue, one must make sure that he is not merely choosing what appears to him to be a light in preference to a dark gray, instead of one color in preference to another.

Lubbock's experiments upon insects are not complete in that he failed to take this factor into account. In his experiments with ants, for example, he put strips of colored glass over their nests, and after a given time counted the ants congregated under each of the strips. *Formica fusca* congregated under these strips in the following numbers: red, 890; green, 544; yellow, 495; violet, 5. After numerous experiments with bees he says: "It seems to me that the preceding experiments show conclusively that bees prefer one color to another, and that blue is distinctly that favorite." Wasps also, "are capable of distinguishing color, though they do not seem so much guided by it as bees." That these insects have color preferences is probably true, but the experiment would be more conclusive if Lubbock had excluded the possibility of the results having depended upon differences in brightness. The choice of red over yellow and violet may have been due to a difference in the brightness rather than in the color of the glass strips.

The probability is very strong that birds recognize colors [illegible] eferences among them; but, so far as I know, defi- [illegible] nents are almost entirely wanting. About color [illegible] the higher classes of mammals there has been a [illegible] surmising and guessing. It is said, for example, [illegible] elight in bright colored ornaments on their har- [illegible] ere is no definite proof of it. Mr. Cornish well [illegible] urrent opinion on this matter. He says: "Do- [illegible] s, which see bright colors other than green in [illegible] more frequently than wild ones, might be sup- [illegible] it the consciousness of such differences in the [illegible] ed way. Yet it is next to impossible to cite an instance in which a dog exhibits curiosity as to color, or identifies an object by its hue. The writer has seen a setter refuse to retrieve a black rabbit because it apparently thought its master had shot a black cat. But a house-living dog shows no preference for a red carpet or rug over a blue or variegated one, and expresses no surprise or curiosity whether its master wears a red uniform or a black evening suit. Domestic cattle are so much affected by violent contrast of white and dark that the presence of a black, white or very clearly spotted animal in the herd sometimes results in calves being thrown of the same colors or markings. But though red is said to irritate a bull, and to excite hunters by association of ideas, the latter statement rests partly on surmise. They are equally excited by the sound or sight of hounds, or of a number of riders, whatever the color of their coats. None of the cats, whether wild or tame, show any partiality for bright hues; and among all the strategems used from time immemorial by hunters, the use of color as a lure for quadrupeds is notably absent. Many birds, on the other hand, have a marked preference for bright colors, and exhibit strong curiosity when unusual tints are shown to them. Among the less known examples is that of the red-legged partridge. These birds abound in the lower spurs of the Lesghian Mountains, near the Caspian, and the native hunters use a device for killing them based on this æsthetic preference of the partridges. By the door of nearly every house stands a wooden frame, on which canvas is stretched, covered with daubs of brilliant colors. This the shooter carries with him, and sets up in front of him as soon as he has discovered a covey. As soon as their attention is attracted he waits behind the screen, until the whole covey run up to within shot, and then fires through a loop-hole in the center of the screen. The Russian government has now forbidden the use of these colored lures, as the birds were being exterminated. It is probable that the idea of their use was first suggested by the interest the birds took in the carpet frames set up outside the houses for weaving the brightly-colored Shusak rugs."[1]

I am aware of but two series of experiments on mammals, except the *genus homo*, to determine their ability to discriminate colors. One of these was made by Mr. Elmer Gates. He experimented with dogs, using small pans of various colors and shades, and colored metal plates. Food was put regularly under pans of a given color or shade, and these were distributed among a great many other pans of different colors and shades. The metal plates were so arranged in a hall-way, through which the dogs passed, that they had to step on them. Plates corresponding to the following degrees of white: 215, 185, 167, 150, 135, 117, 90, 35 and 0.

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[1] Animals at Work and at Play, C. J. Cornish, p. 130.

The method employed in the first series of tests was the same as that used with the forms and sizes. The glasses covered with gray were not used as feeding vessels. The four colors were used in the order blue, yellow, red, green. The main results appear in the accompanying tables which are arranged on the same plan as those under the form tests. The tests have been divided into groups of 30 each. The figures in each vertical column indicate how often the animal went directly to each one of the colors and grays within a group of 30 tests. Again, as explained above, our tables take account only of the glasses to which the monkeys came directly.

It will be seen that the male required many more presentations than the female in order to reach our arbitrary standard of from 24 to 30 right choices out of 30 trials. It will be recalled that the female surpassed the male also in the form and size tests. In the tables for the female we note again the revival of the first association when the third and fourth were being formed. The second association also was strongly revived with the fourth. These revivals were less marked with the male. From these tests alone we cannot infer that the monkeys have a clear perception of the colors, for a discrimination of the differences of brightnesses alone might possibly bring about the results found. The likelihood of the latter alternative is perhaps somewhat strengthened by two relations which appear in the above tables. (1) The association with the yellow was revived more strongly with the green than the association with the blue was. (2) Upon the whole, the dark gray was chosen more frequently with the red and blue than with the green and yellow. It will be seen in the description of the apparatus that the dark gray had a degree of brightness nearer to that of the red and blue than to that of the green and yellow. While the former of these may have been offset by the
hat the association with the yellow was more recent than
he blue, and the latter may have been made less
by the fact that the light gray was chosen somewhat
ntly with the darker than with the lighter colors,
emains the possibility that the confusions named
ave arisen out of a partial or complete failure to
colors as colors.

determine whether brightness or color was the
imination, four control tests were made. In three
empted to determine whether the monkeys could
gra[illegible]s and colors varying by the same degree of
al[illegible]y well. If blue and red, for example, with
b[illegible]ightness of 15 degrees were differentiated per-

TABLE BASED ON THE TESTS IN COLOR PERCEPTION.

Male.

Colors used	Food in Blue						Food in Yellow									Food in Red														
Red	4	4	3		1	2	3	6	7	1	2	3	2	2	1		6	3	5	7	5	15	12	10	13	14	16	21	27	28
Blue	9	9	12	20	28	24	25	20	13	14	9	6	4	4	3	5	12	7	5	9	7	2	6	3	4	3	8	5	3	2
Dark Gray	12	10	11	7		2		1	3	3	5	6	3			1	3		4	3	3	1	5	3	4	2	2	1		
Light Gray	4	2	3	3	1	2	1	1	3	2	1	2				2	3	2	2	3	6	2		2	2	2		1		
Green		5	1				1	2	1	2	1	3			1	1	2	3	1	2	3	3	3	2		3				
Yellow	1								3	8	12	10	21	24	25	21	4	15	13	6	6	7	4	10	7	6	4	2		

Male. ‖ *Female.*

Colors used	Food in Green												Food in Blue				Food in Yellow				Food in Red			Food in Green					
Red	16	12	12	14	11	7	8	8	4	4	3	2	4	2	1		2	4			6	13	28	25	18	6	3	4	1
Blue	1	2	3	2	2	2	2	1	1		1		8	18	19	26	20	12	5		2	1		1	2	4	1	3	
Dark Gray	4	1			2	1	1						5	5	3	2	1	1			1	2		1			1		1
Light Gray	1	3	1	2	1								5	4	4	2	3	1	1						1				1
Green	5	10	11	7	11	19	18	21	24	25	26	28	4	1	3		1	1	1		1				3	12	19	17	25
Yellow	3	2	3	5	3	1	1		1	1			4				3	11	23	30	20	14	2	3	6	8	6	6	2

The figures in each vertical column indicate the number of times that the animal went directly to each of the glasses within a set of thirty tests.

fectly and two grays differing by 15 degrees, vary imperfectly, then color very probably was the basis of the discrimination in our first series of tests. But if the colors and grays were differentiated about equally well then the question would still be open.

In the first of these control tests apparatus (4) was used. The glasses, numbered from black to lightest gray, 1, 2, 3, 4, 5, 6, 7, 8 and 9, will be referred to by these numbers. These tests were made with the male only. Food was put first into the lightest gray, number 9. It was set down then along with the black, number 1, and the monkey was allowed to take the food. These two glasses were presented together ten times, being exchanged at my back and then set down sometimes by crossing them over and sometimes not. Care was taken to avoid routine and regular position. As far as possible the glasses were put in good diffused light, and in such positions that shadows might not fall upon them in a way to make the lighter seem to be the darker. After feeding in the light gray, in comparison with the black, the black was replaced by the very dark gray, number 2, and 10 more tests were made. In this way we continued down the scale of grays from black to light and back again. To avoid the criticism that the food glass, number 9, may have become soiled or have had some distinguishing mark on it besides the shade, I replaced this glass occasionally and also renewed the paper covering. I could note no difference, however, in the number of correct choices when these changes were made.

Assuming that the first half of these tests (800, or 100 to the pair of glasses) were disturbed somewhat by the mere difficulty of learning the trick, and therefore neglecting these and calculating the per cents of right choices for the last half only we get the following results: with (9 and 1), (9 and 2), (9 and 3), etc., respectively, 100, 99, 98, 98, 98, 95, 87 and 77 per cents of correct choices.[1] When the white (mixed with black to form the grays) differs in two grays by only 48° and 30°, as when 7 and 8 were compared with 9, we see a marked reduction in right choices. Yet these grays are so very different that man eye distinguishes them with perfect ease and cer- The difference of brightness in red and blue, however, ly 15°, but the monkeys distinguished them easily even they were mixed up with four other colors; whereas hoice between two grays differing by 30° of white was ith considerable difficulty. If brightness were the basis ssociation in the first series of color tests, the red and

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rresponding per cents for the whole 1,600 tests were 97.5, 96, , 86, 77.5, and 70.5.

blue, differing only by 15 degrees of brightness, should have been confused freely. But they were not so confused. The female, especially, confused these colors but very rarely. We infer, therefore, that the monkeys were probably making their associations on the basis of color and not on that of shade.

This test was followed by a second series of control tests on the following plan, the apparatus being the same as in the preceding tests. I first used glasses 8 and 9 together, putting food in the lighter of the two, in number 9. After 10 tests, 9 was dropped out and 8 and 7 were used, the food being put into number 8, the lighter one. This was continued up the scale of shades and down again, introducing such variations in the order of presentation as would equalize the learning and practice effects.

Taking the results, along with the degrees of white in each of the grays, for the last half of the tests again, it appears plain that in a gross way the per cent. of correct choices agrees with the differences of degrees of white used in forming the grays, and that differences of 27, 32, 35 and 55 degrees only, give results above mere chance; for chance alone should have divided the selections half and half. The difference in the degrees of white between 1 and 2, 2 and 3, etc., respectively, were 35, 55, 27, 18, 15, 17, 18 and 30. The corresponding per cents of correct choices were 94, 83, 68, 52, 46, 56, 50 and 64.[1] These results agree quite well with those of the preceding test, especially if we consider that in the preceding the feeding glass remained of the same shade throughout the whole series of tests. Its image, therefore, may have become somewhat definitely impressed on the monkey. In that event his choices would be based upon an absolute standard in the same way as was suggested in the size tests. In this last series of tests the feeding glass changed with each group of 10 tests. Hence no single image could be of any particular service. It would appear then that if the monkey managed to choose with measurable correctness he very likely had a general notion of a low order, which might be represented by *food-always-in-the-lighter*. The inducement to generalize would be greater in the tests where the change was from the darker toward the lighter grays. For here when 1 and 2 were used the image of 2 might become partly fixed as the feeding glass. But when 2 and 3 were used next the monkey must leave the glass in which he had just been fed and move on from 2 to 3, from a darker to a lighter. That is, shade 2 had to be abandoned and shade 3 selected even though shade 2 was before him. That this was a more severe test than the reverse movement, appears from the fact that here he chose correctly on the average only 69 per cent. of the times, while in the reverse movement, where the lighter glass just used as a feeding glass was each time dropped out and a darker one put in, and where he could, so to speak, lag behind with the lighter glass, he chose correctly on the average 73 per cent. of the times. I do not say that the monkey had generalized, but that we have here something that looks very much like a generalization of a low order. I shall return to the matter in the section on General Notions. The differences of 15, 17 and 18 degrees in brightness with these grays has resulted in utter confusion, while a difference of 15 degrees of brightness between the red and blue resulted in all but a perfect differentiation; hence the inference as in the preceding series is unavoidable, that color was really the basis of discrimination in the color tests.

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[1] The corresponding per cents for the whole 1,600 tests were 86.5, 88, 72, 56, 48, 45; 53.5, and 69.

A third control test was made as follows: apparatus (3) was used to see if 6 grays, varying somewhat more in brightness than the colors did in the color tests, would be selected and associated as readily as the colors were. The shades varied from 215 to 0 degrees of white, while in the color tests the variation was from 215 degrees of white (yellow) to 35 degrees (red). The method of experimenting was the same as that used in making the color tests.

Let us designate the grays from lightest to darkest as A, B, C, D, E and F. Each monkey was fed from the same glass C. It was thought unnecessary to change to other feeding glasses. The male was tested 360 times; the female, 180 times. In the 30 included between the 150th and 180th tests, the male made 13 correct choices; but after that his correct choices fell to as low as 5 out of 30 or to the level of mere chance. In the 360 choices he selected A 27.2 per cent. of the times; B, 18.5; C, 22.5; D, 14.4; E, 8.0; and F, 9.4. Clearly he knew the food was among the lighter glasses, but was unable to distinguish well enough to select accurately. The female in her sixth 30 succeeded in choosing correctly 21 times. She chose A 11.6 per cent. of the 180 times; B, 25.5; C, 43.9; D, 9.4; E, 5.6, and F, 5. In these tests the fact that the monkeys chose B, a glass lighter than the feeding glass, more frequently than D, a darker one, may have been due to a tendency to choose brighter colors and lighter shades, as suggested by Mr. Garner. The male may have been influenced somewhat by his preceding experience in the two series of control tests described above. The female, however, had been fed from gray glasses but 22 times in all, and even then with the food in the darker glass. (See Experiments with Designs.) The results show better association on the part of the female than on the part of the male, but in neither case does the success compare at all with that attained by each when dealing with the colors. The conclusion that these animals have a clear perception of color and are not dependent upon lights and shades alone, again seems justified.

As a final and crucial test apparatus (2) was used. Shades of gray paper were selected by the "Flicker Method," differing as little as possible from the brightness of the colors used. Glasses were covered with these as before, and a color glass with its three equal gray glasses were used together. They were exchanged on the board and presented in the same way that the colors were in the original color tests. If now the animals do not perceive color they should have been brought into complete confusion with regard to the colors and the equal grays since these necessarily differed very little or none at all in brightness. The three gray glasses were used to give sufficient shifting on the board, and thus to exclude the possibility of choice by mere position.

Sixty tests were made with each color in the order, blue, yellow, red and green, all on the same day. These results are shown in the first of the accompanying tables. The data for the second table were obtained eight days later.

COLORS USED.	MALE.		FEMALE.	
Blue	17	27	13	26
Yellow	12	23	27	30
Red	26	28	24	30
Green	28	29	30	30

COLORS USED.	MALE.		FEMALE.	
Yellow	21	27	28	30
Green	27	27	27	28
Blue	26	26	25	30
Red	24	25	26	27

The figures in the tables indicate the number of times that each color was correctly chosen in a set of 30 tests.

In this second series of tests the colors were presented in the order designated in the second of the tables above. Here 30 tests were made with the yellow; then 30 each with the green, blue and red. A second round of 30 each was made immediately afterwards.

The association, with this apparatus, was much more readily formed than in the first color tests when the six glasses were used, partly because the board was now shorter, and partly because there was less of diversity, the three glasses being all of the same gray and there being but one colored glass. The accuracy of the discriminations was so great and the associations so readily formed that there is in my opinion absolutely no question any longer about the monkeys' ability to perceive color.

Color Preferences.

I attempted to study color preferences by feeding the monkeys colored candies, as Mr. Garner did. The candies were handed to the monkeys either on a cardboard or on the palm of my hand. They were separated some distance, and the relative position of the colors was frequently changed. The card or hand was always withdrawn as soon as one of the candies was taken. The male was so much frightened by my coming near the cage that, although he sometimes took the candies, he could hardly be said to have chosen between them. After feeding the female about 100 times she resorted to grabbing with both hands, apparently to make sure that neither of the pieces of the candy should escape her. After the female adopted this method no further tests of this kind could be made with her. No conclusions can be drawn from these tests of mine with reference to color preference. This method of testing in my judgment is very unsatisfactory. A little variation of the card or the hand from right to left may determine the selection, since the distance that the animal moves in getting to them is so small. Further, with a timid animal one gets nothing deliberate enough to partake of the nature of a choice. Most of the animal's attention is given to the experimenter, and it simply makes a quick grab for that piece of candy which is in easiest reach from its position.

Another attempt was made, using a method similar to that employed in making the tests on color perception. I covered
e cylindrical surfaces of glasses with the following colors of
er: green, blue, orange, dark gray, red, yellow, violet and
te. As to their brightness I will here say only that the
red, green and yellow were the same as used in the pre-
g tests. The orange was slightly darker than the yellow,
he violet was darker than the blue.

periments were made with the male first. I presented the
glasses, blue, green, orange and dark gray together. A
el of food was put into each glass, and the animal was al-
d to take all the food before the glasses were taken up. The
of the glasses was changed as before. After 30 presenta-

tions the other four glasses were used. In the first group the first choices were: green 12, blue 1, orange 11, and dark gray 6; in the second: red 2, yellow 12, violet 5, and white 6. Two new groups were now made, each consisting of the two colors most frequently chosen in one group and of the two least frequently chosen in the other group. Presenting the glasses as above, the choices for the first group were: green 5, orange 10, violet 5, and white 10; for the second group dark gray 4, blue 4, yellow 13, and red 9. As a total result so far we have yellow 25, orange 21, green 17, red 16, white 16, dark gray 10, violet 10, and blue 5. Again I threw the glasses into two groups, those most frequently chosen and those least frequently chosen. Now the choices for the first group were: yellow 11, orange 9, green 9, red 1; for second: dark gray 6, violet 7, white 10, and blue 7. The second group here, however, has no value as after about 8 choices he fell to starting in with the glass on the right and to taking all as they came.

The female from the very first began at the left of the row and took the food from each glass in the order of its position. If she has any color preference whatever the association of order completely covered it up. Still hoping to get some signs of color preference from her by this method I selected the two colors which had appealed to the male most and least—yellow and blue. In 30 presentations of these, the food in both glasses, and alternating them right and left, she chose the left glass 28 times. Evidently this indicates a continuation of the former habit. In the other two cases a little noise made by the male in his cage veered her over to the other glass. In experiments of this type, color preference would probably be based on either an æsthetic taste or on the fact that certain colors lie nearer the animal's feeding instincts than others do.

One more series of tests was undertaken in the study of color preference. A cage three feet long, ten inches wide and fourteen inches high was so constructed that the back part could be moved as a sliding door. The inside was painted a light gray. This gave the inside of the box a uniform appearance with no attractive points for gnawing or escape. Eight inches in front were hung two large sheets of colored gelatine—blue and orange. The arrangement was such that very little light could enter the cage other than through these sheets. A vertical partition opposite the middle of the front of the cage and between it and the sheets of gelatine, greatly reduced the animal's opportunity, when in one end of the cage and behind one of the colored sheets, to see and be influenced by the other color. The cage was so placed that direct sunlight flooded the whole of it. One animal was turned into the cage at a time and kept there for twenty minutes. After ten minutes the places of the colored sheets were exchanged. For observation I sat some distance in front of the middle of the cage. By means of the cumulative stop-watch the total time that the monkey spent behind each color could easily be kept. The assumption was that if either color was more pleasing, or less painful to the monkey than the other he would make choice between them and sit in the color most agreeable. The female was in the box during 14 ten-minute periods. In 5 of these she spent more time behind the blue than behind the orange, and 56 per cent. of her total time was spent behind the orange. The male, likewise, was in the cage 14 times, 9 of which were taken up mostly behind the blue. He spent 62 per cent. of his whole time behind the blue. The results were regarded as so very irregular as to indicate neither preference nor the absence of it, and further experimenting by this method was abandoned.

The first time the monkeys were turned into this cage they seemed to be surprised at the change of color on their own bodies; for several times they looked strangely up and down and along their arms, and tried to pick the color off of their hands. This apparatus, in addition to appealing to an animal's æsthetic taste and instinctive habits of feeding, might appeal, also, to his instinctive fear. A timid animal might stay where he considered himself best concealed, and a bold one where he could get the most satisfactory view of his enemies and environment.

The results of these tests on color perception and color preference may be summed up as follows:

1. There can be no doubt that monkeys perceive colors.
2. Two grays having a given degree of difference in brightness are not discriminated as well as two colors having an equal difference in brightness.
3. For accurate discrimination of difference in brightness a difference of about 35 degrees or 9 per cent. of the white constituent of the gray is necessary.
4. The monkeys are able to distinguish colors from grays though the brightnesses are the same.
5. The male appears to have a preference for bright colors, but blue seems to be discriminated against.
6. In two instances there were indications of at least a low form of general notion.

A CONTRIBUTION TO INDIVIDUAL PSYCHOLOGY.

By Norman Triplett, Ph. D., Kansas State Normal.

(By way of introduction the following letter may be reprinted here.)

Emporia, Kan., March 1, 1902.

Dear President Hall:

At the close of a recitation in Psychology a few weeks ago, in which the subject of Number Forms was discussed, Mr. Arthur M. Clark, a member of the class, came to me and said that he had a peculiarity of a greatly different sort. He spoke of this as if half ashamed of it, and said that while he had had it all his life, he had kept it a secret and had never before even hinted of its existence to any one. Inquiry disclosed such a remarkable system of dealing with letters that I have made an effort to unravel the matter, and I send you herewith some account of it. It is told in the first person though the facts given have in large part been obtained as the result of much patient questioning. Extensive as seems the matter presented I can verify Mr. Clark's statement that merely the simple skeleton is here given. He says that the ramifications and their uses extend it unendingly, and that it would fill a book. The first impression one gets from it is that it is an incoherent jumble of nonsense, and indeed it is, so far as any practical use is concerned. More careful study, however, shows it to be a system that, for the most part, is logical and consistent with itself, and that any one might learn, at least in its simplest form.

Three aspects are to be noted in the account given. 1. The origin and development of the various forms or contests. It is a life history. In the increasing complexity of the system may be seen the influence of environment on the growing child. His interest in the letters was the wax on which everything left its impression. 2. His attitude toward the subject from the time when he first became conscious of his peculiarity. He has always regarded the matter with a good deal of mystery. He insists, and is impressed with the fact, that the forms of the contests described grew up without conscious attention or formulation, and in operation went through their changes as mechanically as the changes produced by the moving picture machine. His facility in running a word through the succession of stages necessary to his final result is wonderful, though lately it must be done by a conscious effort, he tells me. When I commented on his power in this regard he said he ought to be able to do it when he had seen it going on all his life. The word picture which he carries of many words is a letter group which means nothing to the uninitiated. Call a word and he instantly responds with the combination making up his word form. Formerly there were large numbers of these in his vocabulary, as most words when first learned passed through the changes and kept the form. In some cases the word has been arrested at an intermediate stage. At the present time, though many yet remain, the regular word has come in most cases to take the place of the old combination. 3. The personal character given the letters from the association made with the pictures from which they were learned, and their peculiar habit of appearing in the character of hypnagogic images, if such they were.

Mr. Clark is a good student, honest and of strong religious character, and aside from the matter mentioned would not be considered peculiar. He says that as a boy he was delicate and played by himself a great deal.

Yours very sincerely,

NORMAN TRIPLETT.

When I was a boy of perhaps four or five years of age, my older brother came home from school one day and told me of the way his teacher had given for remembering the spelling of the word "Aaron." It was: "big A jumped upon little a and crushed out 'ron.'" This led me to think of the letters "A" and "a." What relation have they to each other? Why is one larger than the other? It was from questions like these that the conception of a struggle among the letters, as described below, arose in my mind. Another element in the process of endowing the letters with force or personality, I believe, came from the alphabet picture books where the letters are pictured in different characters. From these sources the interest in the letters developed which has been so large a part of my life.

The struggle referred to is not a struggle of the letters as they appear in the alphabet but as they appear in words; that is, it is a war of words. The struggle may take any one of four forms according to the word to be dealt with. The four forms, however, developed at different periods in my life and from different causes. In order to understand the struggles of the letters it is necessary to know the values attached to them. The alphabet appears to me to be divided into series of three letters each, preceded by the capitals A B C, as follows: ABC, abc, def, ghi, jkl, mno, etc. In the series "abc," "a" is worth two of "b" and "b" is worth two of "c." "c" in turn is worth two of "d," the first member of the next series, and so on throughout the other series. "a" and "b" taken together are equal to "Cc," "bc" is equal to "ad," "ac" is equal to "bb," "bd" is equal to "cc," and "cd" is equal to "be," and so on through all the series.

Now in this scheme d, g, j, etc., the first members of the succeeding series are regarded as the descendants of "a." The same relation exists between "b" and e, h, k, etc., and also c and f, i, l, etc. Capital A, B, and C, are considered a degree higher than small "abc," and large A holds the highest possible position in the scale of values. These three capitals are not much used, but capital A in particular is necessary when the method employed in treating a word is the one which reduces all letters to the letter "a." Each series of three letters decreases in value as its distance from ABC increases.

In my different systems of treating the letters of words certain terms are used to designate the various processes and these require definition and explanation. "Combination" is fundamental. It involves the arrangement of the letters to the best advantage for the purpose required. Three principles are embraced in it: 1. the arrangement of the letters for expansion in the manner described later; 2. placing two letters of the same kind together to make one of the next higher, for example, "cc" equals "b" etc., and 3. is combining a descendant of "a" with a descendant of "c" which would be worth, as said before, two descendants of "b." When two letters are combined to make one of the next higher rank, the single letters lose their own characteristics and assume those of the letter that they are combined to make; thus, in "cc" equals "b" the combination "cc" is treated as "b."

"Expansion" is the term employed for the following process: if, for instance, the syllable "ac" occurs as in "accept," it will expand into "acbd," because, according to my system, "ac" always takes "bd" after it when expansion is used; "a" has the same relation to "c" that "b" has to "d," from their place in the alphabet, as before stated, and the product of the means is always equal to the product of the extremes. So in the word "baby," "ba" would be preceded by "dc" and the reason for this change in position is that "c" or its descendant must always precede "b" or its descendant and the product of the extremes again equals the product of the means. Where in any word, the letters are all used in other combinations, leaving "a" standing alone, the "a" assumes to take a "c" or its descendant and expands into "acbd," or it will take the equivalent if corresponding letters of other series are used. For instance, the word "Bella" will be seen in the mind to take the following form, "lblea." The change of position of the letters "bell" is made because "c" or its descendants must always precede "b" as stated above, and the letters "ll" are descendants of "c." The "a" left standing alone will assume to take "l" for some reason not understood, and the "al" will expand into "albm" and the word becomes "lblealbm," and this is my mental image of the word Bella, and in like manner are treated all words in which the principle of expansion is used.

"Suppression" is a process used in connection with "expansion," and is made use of when the system of expansion produces more letters than is necessary. In expansion four letters are always involved; by suppression this number may be reduced to two. For example, in the word "railroad," since "r" from its place in a series is the descendant of "c," "ar" ("a" of course preceding a "c") may be said to be equal to the letters "bq," since "ac" = "bb" and "ar" will equal "bq," "q" holding the same position as "b" in its series.

Then the word "rail" appears as "bqil," which, when the letters assume their proper order becomes "iblq." The explanation being that, as said before, "i" corresponds to a "c" which must always precede "b," and "l" precedes "q" for the same reason. The word is then seen to be equivalent to four descendants of "a," (for "ib" corresponds to "cb" and so in like manner does "lq,") and "cb" = "ad" and "d" is a descendant of "a," and thus the word "rail" is equivalent to "aaaa." "road" the second part of the word, appears as "ardo." Now the "ar" expands into "arbs" ("r" standing for a "c" and "s" being first in its series and hence standing for an "a"), and the "do" expands into "doep," for some letter must go with "o" that will make their product equal to "d" by some fourth letter which is a descendant of "a" below the second term, *i. e.*, the third and fourth terms, respectively, are the first letters below the first and second terms, repectively. This is a general law or principle true for all cases. By the method explained above "bqil," "arbs" and "doep" are each proved to be equal to four descendants of "a," and by combining the results the entire word "railroad" is seen to equal twelve descendants of "a." This has been reached by the method of expansion. Given a game of words in which "railroad" or any word that makes 12 descendants of "a," is found when the game requires but 10, "suppression" may be brought into play to reduce the number. In the word railroad suppression may be used either on the "do" or on the "ar;" that is, the "ar" may be expanded as "arbs," and the "a" and "s" dropped when the whole word becomes shortened to "iblqrbdoep," and we have the ten descendants of "a" required. This may, in like manner be reduced to eight, by applying the method of suppression to "doep" that is, by the cancellation of "d" and "p," "oe" is left and the word becomes "iblqrboe." Which form the word will finally take in my mind, however, depends upon the number of descendants of "a" required at the given time in connection with some other word or phrase, for in some instances more than one word is required in developing a certain method. Some words are rigid and furnish just a definite number of descendants of "a," while others, like the word "railroad" used above, are flexible and accommodate themselves to the needs of the given case.

"Promotion" is raising a letter from one series to the one next above in rank. Skipping a series is not permitted; but promotion must be made by moving through one series or group of letters at a time. "Demotion" is reversing the process. The two processes are inseparably connected, promotion of one letter requiring the demotion of another of the same line of descendants, or of the letter used in connection with it.

The object of the processes named is to bring into the same series the letters being combined. For example by expansion in the manner indicated under the explanation of that term, the word daily takes the form "diejalbmy." Suppose we wished the "diej" and the "albm" to be reduced to the same series: Demote the "a" of the second group to "d," its first descendant; the "m" will be promoted to "j" a series above it in rank; the "l" used with the "b" may be promoted to "i," the first series above it, causing "b" to be demoted to "e," the corresponding letter of the series next below; and the "albm" becomes "diej," and hence the form desired as to series.

In "diej," by demoting the "d" to "g," the "j" may be promoted to "g." The process of changing the "d" and "j" to "gg" are simultaneous or seem to be so. Since "ie" is equal to "dj," it also is immediately thought of as "gg," and as the "albm" likewise became "diej" it also dissolves into "gggg" and my mental picture of "daily" becomes "gggggggy."

The principles thus explained are used in several ways and these I call games or contests. These games show a process of evolution in my mind, after using one for a few years till the novelty wore off I would take up another. I did not originate these contests, however, not consciously at least. They simply grew. The variations which have appeared seem to have been suggested by different causes.

CONTEST 1.

A few years after I had begun to speculate about the mysterious character of letters as mentioned above (I presume I was about seven or eight years old), my grandfather told me a story, the thought of which was that no force exists so great but a greater may be found. I think it was a poem, and as I remember it an ant was devoured by a dove which in turn fell a prey to a hawk. The hawk was then captured by an eagle, and the eagle next fell before the arrow of a hunter. Suddenly this game presented itself to my mind as an illustration of the thought of the poem.

It consisted of a contest between two or more words where several words stand for the same thing. As a result of the contest the word that won out seemed to recommend itself for preference among synonyms.

Recalling the division of the alphabet into series of three letters as "abc," etc., in this contest every descendant of "a" or letter which stands in the position of "a" in a series, is thought of as "a," every descendant of "b" is thought of as "b," and every descendant of "c" is thought of as "c." Other letters are not taken into consideration as such, but are regarded as so many of "a," "b," or "c."

Let us take for illustration "mind" and "brain." Though these words are not synonyms, I formerly thought of them as such. These words became engaged in one of the many contests of that period, to determine which should have the preference in use. Their values were found as follows: the letters in the word "brain" took the order "a-rb-in." Since "r" and "i" are descendants of "c," and "n" the descendant of "b," "r" and "i" preceded "b" and "n," as a "c" must always precede a "b" as stated earlier. Making the proper substitutions for the values of the letters we had "a–cb–cb." Since "cb" = "ad," the word equals "a–ad–ad," but since in this form of contest all descendants of "a" are considered as "a" the word became "aaaaa." If the word reduced to five of "a" or a multiple of it, the combining process was indeterminate. If carried further the process was as follows: "aa" would combine into a "c," so two pairs of "a" from the five were each combined into a "c" giving "acc" and the process could be carried on with the three letters unendingly. At present this is not done, but it was followed till the principle was seen.

The order of the letters in the other contestant (the word "mind") remained unchanged, because the combinations occurring in it were already perfect for this contest. "m" is a descendant of "a," "i" is a descendant of "c," "n" is a descendant of "b" and "d" is a descendant of "a." The word is practically the same, therefore, as my regular group "acbd." Since "cb" = "ad" the word is equal to "ad–ad" or "aaaa." My mental picture of this word is regular, that is, I see the word "mind" because the letters stand in their proper order.

When a word has been reduced to "a"s, the number it contains whether odd or even, must remain so throughout the entire process. Sometimes the word will not reduce to "a"s, in this case the value must be determined by other methods. A word that reduces to four "a"s as was true in the case of "mind," is inferior, because to continue you must reduce both pairs of "a"s to "c"s, so the "aaaa" would become "cc" but this is equal to "b" and an end is reached; while in "brain," as was seen, the combinations may go on indefinitely and it is therefore a better word to use.

The contest just described is an actual one. A teacher once told me to "use my brain" and at another time to "use my mind" in the performance of some mental task, and thinking they were synonyms I wondered which was the better word to use. The words were therefore tested by the method described and as a result I decided to use my brain. Such contests were always going on in my mind but I remember this case particularly.

CONTEST 2.

This contest is similar to the first. I think it originated when I was about nine or ten years old and had begun the study of United States money. The idea of fives and tens, on which the system is based, appears to have been carried over and merged with my interest in the letters. The fact that five is the number most agreeable to me seems the result of the former connection. I like numbers in which the sum of the digits is five or a multiple of five, as 1900, 122, etc. Numbers below 100 are always thought of as a certain number of fives and a remainder. Other than as stated I have no number form.

The object of this contest is to reach a balance, or to reduce words to five "a" s or a multiple of five. Here, also, the descendants of "a," "b" and "c" are thought of as "a," "b" and "c," just as in the previous contest. By proper combination five "a" s will become "A," and the value of a word is determined by the number of "A"s and the fractions thereof. "a" is considered worth one-fifth of "A," "b" is worth one-tenth of it, while "c" is worth practically nothing on the last round, since if a "c" is present the "ac" equals "bb" and "bb" equals "a" for two-tenths equals one-fifth. The "c" is therefore practically eliminated.

To illustrate this form of contest take the words "diet" and "food." "Diet" appears as "di-et." "di" expands and becomes "diej" and then the word appears as "diejet." The "diej" is equal to "aaaa," for "d" and "j" are each descendants of "a" and therefore in this system equal to "a." Further, "ie" is equal to "dj," by reason of its position, "i" being a descendant of "c" and "e" a descendant of "b" and therefore equal to "aa." Since "e" and "t" are descendants of "b" they are from their mathematical relations, when combined, equal to "a" and thus the word "diet" equals "aaaaa" which are equal to "A."

Taking the other contestant, "food," the word first assumes the form "doof" the "f" and the two "o" s are each descendants of "c," and "d" is a descendant of "a" so the word next appears as "accc." The "a" taking its proper place before "c." The "a" taking its proper place before "c" is combined with one "c." The "ac" thus combined is equal to "bb" and the word then appears as "cbcb," by the two "c"s taking their usual place before the "b"s. As "cb" equals "ad" the form changes to "adad." Since "d" is a descendant of "a" the word becomes "aaaa," which is less than "A" by one-fifth. "Diet" is therefore the winner in the contest and is to be chosen in a selection of synonyms. In this case, however, though "diet" was thought to be the proper word, common usage and other considerations prevented my using the word very much. But in general my choice of words is determined in the manner indicated.

CONTEST 3.

This contest had its origin when I was about the age of ten or twelve, after I had learned the game of checkers. Its object is to promote as large a number as possible of the letters of a word to "A." In order to promote one letter another letter must be demoted as far as the first is promoted. The letter must not be eliminated, however, *i. e.*, promotion and demotion must remain within the limit of the alphabet. One vantage play in checkers is to get as many kings as possible, so, in this game, a letter promoted to "A" is considered a king and the steps taken by a letter to gain the rank of "A" are thought of as moves toward the king's row. The process involves the changing of the letters to "a" descendants, then follows the possible promotions to "A." The word having the most "A"s is the winner.

I was told that all good generals were good checker players, so the first words entering into this form of contest were the names of generals. For instance, the words Grant and Lee, were thus used. Grant takes the form "ag–rn–t." In this combination "rn" equals "ms" because "rn" is the central part of the expansion "mrns" made by expanding "mr" in its usual way, as explained under the term "Expansion" and its equal "ms" is substituted for it. The word "Grant," therefore takes the form "agmst." Demotion and promotion produce the following changes: "s" is demoted to "v," and "a" is promoted to "A"; "m" is demoted to "v" and "g" is promoted to "A"; the final form of the word "Grant," therefore, becomes "AAvvt." The word "Lee" takes the form "le–e." The "le" is the central part of the expansion "dlem," made by expanding "dl," and thus "dm" is equal to "le" and is substituted for it. The word "Lee" now takes the form "dme." The "m" is demoted to "s" and "d" is promoted to "A" and the group becomes "Ase." We thus see that the word "Grant" is the winner, as it equals "AAvvt" while the word "Lee" equals "Ase."

Another element that seems to have entered into this third form of contest was drawn from political life. It was about this time that political matters began to arouse my interest. It was noticed that candidates for office were generally promoted step by step, and that the success of one candidate meant the displacement of some other man. Thus the names of candidates and political leaders also became material for contests.

CONTEST 4.

These contests, as has been said, have been an evolution. This fourth and last is the highest form, and to me the most interesting. It seems to have originated a few years ago, at the time when I first watched a football game. I did not understand the game, but saw that the men were placed to the best advantage, and as this always seemed to be true of the letters, a contest was evolved in my mind. After I had slept a night or two, it worked itself out. I did not consciously do any formulating of the game. For a long time I enjoyed watching the moves and changes of the new contest for the novelty of the old games had from long use worn away.

Football seemed to me a mere trial of strength, though the men appeared to be massed at one point, and when this new contest came up the letters had the same characteristics as the players. The object of the contest was to convert the letters of opposing words into descendants of "a," to bring them as near to "a" as possible and yet remain together.

As the games of football were between educational institutions, I at first found myself working with the names of these institutions; as Yale vs. Harvard, Princeton vs. Dartmouth, University vs. Normal, etc. In the first named, Yale vs. Harvard, the letters of the first word happen to be such that they are permitted to retain their regular order, "y-al-e." The "al" is a combination that expands always into "albm" and the word becomes "Yalbme." The next change that I saw was the combination "Ygggge." Those grasping the principle will see that "lb" is equal to "am," by promoting the "m" to "g" the "a" is demoted to "g" making similar changes with the "l" and "b," and massing, our four group "albm" became "gggg."

In the case of Harvard the letters also retain their natural order and the word appears as "H-ar-v-ar-d." Each "ar" being the nucleus for an expansion becomes in the regular way "arbs" and the word Harvard is transformed into "Harbsvarbsd." Now since "rb" equals "as," by promotion and demotion, each pair becomes equal to "jj;" and by massing we have the aggregation which was seen as the third word change: "Hjjjjvjjjjd." To reduce this to "g"s, the principal element in the combination resulting from the word Yale, we promote each alternate "j" to "g" and demote the remaining "j"s to "m." Placing like letters together we have "Hggggvmmmmd." Harvard is the stronger word, for the result shows as many "g"s as in Yale and of the remaining letters more are of a higher order. This result is not attained because the original word had more letters than its antagonist Yale but because its letter combinations happen to give more opportunities for expansions. It is this factor, indeed, rather than the length of the word which determines the outcome in a test of strength. Let us take to illustrate this the words Normal containing six letters and University containing ten. Applying the method explained we find that Normal is the stronger word for it contains more letters of a higher order than the latter. The form for Normal being "jjjjjjmmpp," that for University being "mmmmmmvvv."

The whole subject in its various forms, as outlined above, may be only a substitute for the day dreams so common among boys. I spent the time with this that, I presume, most boys spend in day dreaming. I remember having only two or three day dreams. It has never bothered me in study hours for as soon as I wish to study it vanishes leaving my mind clear.

In order to develop the results attained with words it was only necessary to direct the attention to the words when the letters seemed to take their different forms much as the images of a vitascope. A word in process of change did not take its ultimate form at one move but the changes were made as explained in the contests, and each step was separate and distinct, though very rapid, as the final result seemed almost instantaneous. After the changes began my mind seemed to be passive and I was merely an onlooker and not a conscious director.

Until I was ten years of age I was content to watch the contests without trying to inquire into their meaning. I then began to question myself as to the meaning of it all. No solution was reached. The idea, however, came to my childish mind to make the following application of it: I resolved to cram myself with facts and to learn all their was to know, thinking that when I was asked a question I could direct my attention to it and the answer would unravel before my mind's eye without effort on my part. In accordance with this plan I conceived the idea of mastering the text-books at school and at the same time of acquiring other subjects at home, beginning with the Bible. I thought that by memorizing everything as I went along, it would be unnecessary to give it further thought as it would present itself of its own accord when needed. The plan was carried out most completely with History. Soon I could repeat the account given in Barnes's History of the Revolutionary War, beginning with "England treated the settlers as an inferior class of people," etc., and continuing to the close of the war. I committed portions of the Bible in the same way. I expected to memorize the whole of it and thus become an authority on the subject. So in other fields of knowledge.

This idea thus became an incentive to study and I worked faithfully from about ten to fourteen when the reaction set in. I saw that the task was too great and became discouraged. I decided that this was not the solution of my problem and cast about for another. By centering my mind upon the problem for some time the means of solution would seem to accumulate and I thought that if I could hold my mind on it long enough that all the material for solution would be gathered up and then must unravel before my mind. At times I would appear to be on the verge of success, but the thought of being so near the goal would divert my mind and the accumulated material would roll up in a ball and burst as a bubble. After an effort of this sort it would be fruitless to attempt it again for a week.

For two or three years past I have endeavored to rid myself of the whole matter, as I gave up any possibility of a solution and thought it useless to have the mind burdened longer. I found it difficult to do so, however, and my mind continued to be occupied with these peculiar contests until I began to write about the subject some weeks ago, since which time it has cost an effort to think of it all. The word formations now require a conscious process, *i. e.*, they will not arrange themselves of their own accord as formerly.

Another phase of my deep interest in the letters and especially the letter "a" remains to be mentioned. From the very first the letters seemed endowed with life, and for many years on retiring at night they would all gather around my bed. Each letter always retained its own personal characteristics. These they seemed to have derived from the letters in the A B C picture books given me. When they first began to appear I could see the letters shining through them; these faded in course of time and only the figures were left. Some of the letters were brownie-like figures, others were animals. "a"s body was the shape of small "a," "H" was a hog, "K" the "kicker"—always ran around with his right leg held stiffly in front, etc. After assembling they would all perform the most amusing acts which would be remembered and laughed at for days. I never mentioned the matter to any one else, however, because I dreaded that people would think I was silly.

It was long before I discovered that I was "a" or rather that "a" was impersonating me. I noticed that while the other letters were going through their own particular performances "a" often took the part of an observer. He was a special character and his many funny actions were differently regarded by me. I could see that he went through at night what I had done during the day. If I had any mishap "a" would incur the same misfortune at night. Some of these are still vivid in memory, many are forgotten. I remember riding home on a load of hay over a rough road, and when I had retired I saw "a" perched upon a big, jolting load of hay hanging on to the center pole for dear life. One day I lost my temper with a schoolmate. The teacher gave me a severe lecture and told me that if I did not control myself my head would grow out of shape. When the figures appeared that night I noticed that "a" was in great trouble and was not joining in the good time the others were having. His head had become elongated and he would take his hat off from time to time and groan. Subsequent fits of temper on my part always caused further additions to his long head. On one occasion he thought that if he could tie his hat down tightly to his head he could prevent any further swelling. I became angry at something, however, and his growing head lifted the hat so high that it caused the string under his chin to choke him. He prevailed upon "e" who was a dancing lady, to cut it with her scissors. All this doubtless seems fanciful to others but it was very real to me. It was an ever-changing drama enacted for my own especial benefit and I enjoyed it. The figures would at times become engaged in quarrels and would do and say very funny things. I could hear the talking very distinctly.

LITERATURE.

An Introduction to Psychology, by MARY WHITON CALKINS. The MacMillan Company, New York and London, 1901.

"The book is written in the conviction that psychology should study consciousness, both as a series of complex mental processes, or ideas, and as a relation of conscious selves to each other;" there are, therefore, to be considered both "the psychology of ideas, the study of succeeding facts of consciousness without reference to conscious selves, and the psychology of selves, that is, the study of consciousness as the experience of related selves." The first large division of the work separates the treatment of "structural elements of consciousness" and of "concrete conscious experiences." This two-fold investigation of the "normal consciousness" is followed by a briefer account of "comparative psychology and abnormal psychology." At the end of the book stand an appendix and a bibliography.

After twelve pages on the "nature and methods of psychology," the student (the volume is intended to be a text-book) begins, at once, the study of sensation. A brief page hints at the nature of psychological analysis, without, however, making clear the essential and vital distinction between an analysis of 'objects' and an analysis of mind—as when the author speaks of the sensational elements of "rich color and graceful form" (150). It is, clearly, incorrect to speak of structure of mind as the collection of heterogeneous bits and scraps of the 'outside' world. Such a confusion is especially deplorable in a text-book for elementary students.

Most of Part I is devoted to a discussion of the various sensational elements. The definition and discussion of 'sensation' and 'sensation element' are postponed until the concrete facts are set down. The consequence is that the reader knows only by looking ahead exactly what is the author's distinction between the 'element' and the 'sensation.' Other elements are the 'attributive' elements of pleasantness and unpleasantness, the "feeling of realness" and the various "relational elements." The treatment of the elements is followed by a brief chapter on attention, in "its primary meaning of clearness or vividness,"—"a simple relational experience."

The point of greatest interest in this part of the book (Part I) is the author's development of the elements of consciousness. The outline departs but little from the scheme proposed by Doctor Calkins in her paper on "Elements of Conscious Complexes" in the *Psychological Review* (VII, 377). The element of consciousness is defined as "a distinct and further unanalyzable feeling or fact of consciousness." Sensational elements are distinguished in several ways: (1) they are "present in every concrete, conscious experience" (psychological criterion); (2) they correspond to some assignable change in peripheral end organs (physiological criterion), and (3) almost every sensational element has a distinct physical condition (physical criterion). There are three sub-classes of these elements; qualities, intensities and extensities. "The fundamental ground for this division is the observed distinctness of these groups of elements." But the division rests, also, on the two types of serial arrangement under which the elements fall; direct serial arrangement, in the the case of intensities and extensities, and indirect, in the case of qualities.

Curiously enough, the author's elaborate classification of elements is drawn very largely from James's Principles. The sensations are said (114) to correspond to his "substantive facts of consciousness;" the attributive elements (affections) are opposed to the substantive states (because they seem "'to belong' to other elements"), and the relational elements are made to correspond to the "transitive states" of the Principles (133). It may, however, be remarked, in passing, that it is not at all clear that James conceives of these states as classes of 'elements.' In fact, he speaks of the substantive states ("lingering consciousnesses") as sensations, images, percepts, concepts and thoughts (I, 247). It is to be noticed that he is giving the characteristics of the continuous 'stream of thought,' among other characteristics the "different pace of its parts," and is, apparently, not making an analytic quest for ultimate elements. Miss Calkins, it is true, uses the term 'element' in a new sense, but not in the sense of the 'lingering consciousness.' Any final qualification she conceives as an element. She forfeits her right to the term with its old connotation when she passes (*cf. Psych. Rev.*, VI, 507) from irreducibility—the usual mark of the element—to simple characterization or qualification (*cf.* Hume's discussion of *distinctio rationis*). This modification of meaning disregards, it is clear, the very important difference between analyzability and a plurality of properties or characteristics; between a subject—to state the case in logical terms—that can be expressed in simpler subjects and one that is capable of receiving more than one predicate. It is, *e. g.*, no more a dissection of the sensation 'red' to add that it has intensity and extent than it is a dissection of the element 'oxygen' to add that it has the atomic weight 16 and possesses an affinity for free hydrogen. If one were really dissecting, one would be able, in the first instance, to put intensity and extent together and get 'red,' and in the other, to add atomic weight and affinity and produçe oxygen. There is, without doubt, an essential difference, from the point of view of analysis, between the qualitative moment and the other moments in the sensation. The author has, herself, hinted at this essential difference by saying, after James, that one has continually 'more and more' as one rises in the intensive and the extensive series, but 'more and more difference' in the qualitative series. Now this is very much like saying that in one case the 'thing,' the 'element,' is not changed—only its amount is changed; while, in the other, a new element is continually appearing;—an element more and more different in kind, not in amount. The 'extensity' series of elements meets with the special difficulty that any member of such a series is divisible and, therefore, complex. The same argument cannot be made to do duty against 'extent' conceived as an attribute, for subdivision does not, in that case, affect the simplicity of the element. This is quite apart from the question of the doubtful propriety of making extensity (if this is to mean more than the invariable arrangement of qualities in a peculiar series) an analytic determination.

Since the sensation element is a single characteristic of the sensation, it is somewhat surprising to find that a similar analysis of the affections (attributive elements) is not attempted (123). Surely, no one would deny that pleasantness and unpleasantness of are varying intensities. Experiment shows, *e. g.*, that it is perfectly easy to initiate comparison of the degrees of affective qualities. Again, it may be urged that since the affections are 'attributive,' their dependence upon other contents is a separable characteristic which destroys the elemental nature of the affection. The same point may be raised against the author's 'relational' elements. These are characterized not only by their quality (*e. g.*, 'like,' 'more,' 'one'), but, also, by an unfailing dependency upon more than one other conscious experience. Miss Calkins, herself, speaks of this as another "characteristic;" although she makes it, in the writer's opinion, wrongly, a 'reflective' characteristic. But if reflective then extrinsic, and if extrinsic, a mere external connection.

The *Introduction's* neglect of the temporal aspect of consciousness is decidedly unjust. No mention is made of it, so far as the reviewer remembers; although it is discussed in the earlier article on the attributes (*op. cit.*, 510).

It is entirely natural that the volume under discussion should pay little attention to sensations for their own sakes. They are simply "complexes of invariably combined sensational elements" (109). How the color is 'bound up' with the brightness and bigness; what manner of connection obtains within the sensation, we are not told. To be sure, this is said, later, to be a case of "fusion," but fusion, like "association," is, for the author, an objective, 'reflective,' not an inherent form of connection. The distinguishing characteristic of the fusion—"the synthesis of peripherally excited, conscious elements"—is said to be physiological: "each one of the combined or fused elements must be directly excited by the stimulation of an end-organ." There is really a rare opportunity for some one to write a systematic account of the simpler conscious complexes and the various forms of connection. The *Introduction* disposes of the problem by saying that synthesis may be regarded either subjectively or objectively. If it is approached subjectively, introspectively, all that is found is a "relational feeling," a feeling of connection which is prominent "in judgments and general notions," but "is 'swamped' in sensational and affective elements," in the case of percepts, emotions and images. Looked at objectively, "the connection between processes is not a peculiarly psychic phenomenon, but is a general fact, common to every science. . . . . It is not immediately realized, but is reflectively 'known about' the connected facts of consciousness." Fusion and association are the two types of the second mode of synthesis. Now it is difficult to see how a connection which is really conscious 'stuff' can be regarded objectively as a mere 'reflective' bond. This is surely 'atomism' in its most vicious form. The analogy with chemistry and physics, which are said to take their connections 'for granted,' is very misleading; both because (1) these sciences assume that no material (matter) appears when elements unite, and because (2) every combination of physical elements does call for an account of all the new characteristics and modes of reaction that issue when elements combine. Again, we may ask, what is the appropriateness of naming an external, 'reflective' connection of elements a 'fusion?' And how is one to 'fuse' elements in the cool process of reflection? The problem is made doubly serious by the manufacture of a vast number of new elements—intensities, extensities and relational feelings. Think of trying to weld, in the chilling flicker of meditation, "the feelings of redness, yellowness, colorless light, brightness, bigness, odor, coolness, pressure from joint and skin stimulation and pleasure" (158). The author partially redeems the situation by deserting her definition of fusion in writing of 'fusion degrees,' the closeness with which the diverse elements are connected. The closeness or looseness of a fusion is, certainly, a part of the experience, a direct mode of consciousness which does not wait upon an *ex post facto* inquiry. But if fusion and association are external connections, the distinguishing mark which separates the two types is doubly external: the connected factors are, in the one, peripherally excited, in the other, one factor, at least, is centrally excited. But whether the form of connection is different in the two cases, or whether the factors connected are qualitatively different, in the two cases, we are not told. We must infer, therefore, that the chief types of synthesis are not necessarily different themselves, do not even synthesize different materials, but that they have different physiological antecedents. We cannot regard them, then, as psychological classes.

The author finds two attributive elements, pleasantness and unpleasantness. The elementary student would, perhaps, have been more instructed by a full discussion of the affections themselves and a briefer account of physiological theories of their origin.

The treatment of the relational elements is spoken of as "simply a developed and systematized statement of the teaching of James." There is also apparent in it, however, the strong influence of the traditional English School; Locke, Hume, Mill and Spencer. The reinstatement of Spencer's term, 'relational feeling' (*i. e.*, a feeling that relates other feelings), in place of 'transitive state'—James's very apt name for certain aspects of consciousness—clearly marks a return to the more traditional view of relations. The later literature on the subject, even the important contributions of the Austrian and German schools which take up the problem in a fresher and more interesting form, seems not to have been taken into consideration. One is really disappointed to find nothing new in the chapter. Analytic work in psychology is, without any question, difficult and there is a constant tendency to invoke 'the elements' for a miraculous multiplication of raw materials; but, although marvellous increase is reported, from time to time, in various quarters, there is usually good ground for skepticism when the discovery of a new lot of elements is announced. The enormous impulse toward analysis, which is characteristic of any new science, has, undoubtedly, overshadowed the problem of synthesis, but the problem cannot be successfully evaded by the introduction of raw relations. For the physiological substrate of the relational feelings, the author adds to Spencer's crude hypothesis the only less crude associationist conception of Flechsig and suggests, accordingly, connecting fibres and certain cells in the association-centers.

A striking and almost bizarre exhibit of relational elements is introduced in the chapter on attention, where the emphasis is laid on the element of 'clearness.' This is really an object-lesson in the intemperate use of relations. If intensity and bigness were to be considered as elements, it is not difficult to make oneself believe that clearness (an indubitable feature of attention) should, likewise, be considered as elemental; but it is not so easy to see why clearness should be made a 'relational' element while these others are not. What, one may pertinately ask, does it relate? To detect the fundamental fallacy involved here it is only necessary to contrast the account under consideration with, *e. g.*, Kuelpe's treatment of attention as a state of consciousness, in which contents undergo modification in various directions—clearness, duration, reproductivity;—a state and not a definite irreducible bit of consciousness.

Miss Calkins's illustrations of the fact that "we sometimes attend to experiences which are not affectively toned" (141) seem to have been unfortunately chosen. The "well-known phrase" is surely attended to, not because it is insignificant, but because it is 'well-known,' familiar and therefore, pleasant; likewise the "æsthetically indifferent face, if familiar" is attended to for a similar reason. I cannot agree that "many acquired interests are indifferent." They are, it may be granted, often less strongly toned than 'primary interests.' This is natural, because acquired interests mean, until acquirement is perfected, constant fluctuation and, hence, a low degree of attention. But no one that insists on the invariable presence of affection in the state of attention would, I think, be so rash as to affirm that clearness is "identical with pleasantness or unpleasantness." Such an identification would, indeed, scarcely be considered except by a theory that makes attention an element-in-consciousness, possessing a single characteristic. When, on the other hand, attention is regarded as a state or condition which affects the whole range of consciousness, there is no incongruity in giving it half a dozen predicates.

The second part of Book I deals with "concrete mental experiences." It discusses, in their two-fold aspect of idea and of "relation of a self to other selves," fusion and association (to which reference has already been made), perception, imagination, memory, thought, recognition, emotion, volition, belief, will, faith and also certain "typical personal relations." The line is drawn somewhat too closely between this section and the first part of the book. Analysis is undertaken, in the author's opinion, merely for the scientific purpose of enumerating exhaustively the fundamental features of the psychic experience. She intimates, at the beginning of part II, that she is done with "this 'post mortem study' . . . . of those 'artificial abstractions,' the structural elements of consciousness and will turn" to the consideration of "'entire conscious states as they are concretely given to us.'" This sharp distinction between analysis and the study of the idea is, however, partially erased later by the qualifying, if contradictory, statement that "scientific acquaintance with an idea . . . includes . . . . analysis into structural elements" as well as explanation.

Miss Calkins's argument for a psychology of selves appeared before the publication of the *Introduction* (see *Philos. Review*, IX, 490). It distinguishes 'atomistic' psychology—"a structural science of contents of consciousness"—from the "science of conscious selves."

This dichotomy calls for two or three general remarks. (1) It is not evident, in the first place, that a structural and an atomistic psychology are identical, although it is historically true that the two have not been well separated in practice. A structural psychology that is no more than a diligent search for atomic units scarcely deserves the name of a science. It is only the initial chapter to a science. Mind, considered for its own sake, is surely more than mental atoms, and requires something more than an analytic method, important as this is. It is, by all means, unfair to the facts to classify, as 'atomic' all investigations into consciousness-as-such. 'Structure' implies tissue and organization rather than atoms. The fashion (or the passion, should one say?) for using biological analogies in everything not-biological may not subside for some time; but, meanwhile, do not let us obscure our terminology by blending chemical and biological figures. Again (2) the antithesis between the two main types of psychology is not entirely clear to the writer. Why should a study of the 'self,' any more than of any other of the uses to which mental processes are put, be set over against the investigation of the mind? It is true that the apprehension of the "I" or of the "thou" is of frequent occurrence in experience; but so, also, is apprehension of countless other things. The self, as an idea or a concept, is only one among many. Surely, a psychology of selves cannot take the place of an exhaustive examination of the multitudinous offices which contents-of-consciousness fulfill. The recognition of conscious individuals, of 'shared' experiences and of 'attitudes' is certainly an important feature of mind, or better, perhaps, of the psychophysical organism;—but it is, by no means, the only one. The psychology of selves cannot, then, be considered as antithetical, or even complementary, to an 'atomistic' account of mind, for it reveals only one aspect of consciousness-in-the-mass, of what James has so ably treated as the "stream of consciousness." Neither can it hold a similar position with respect to a 'structural' psychology, for it, by no means, exhausts the 'functions' which are the inevitable correlates of mental existence. In the third place (3), it is necessary to draw a line of distinction between a science and the use of scientific method. No one, I imagine, will deny that the self can be treated by methods and appliances common to the sciences; but it is doubtful whether it furnishes material for a science. If such a science comes into existence, it will, undoubtedly, come as a social psychology.

Consciousness of self, we are told, can only be described—apart from analysis, at which, curiously enough, the author makes no attempt—as "consciousness of myself contrasted with other selves, and second, as consciousness of my varying relations or attitudes to these other selves." This fact shows the essentially "social nature of the self," and from this, again, follow its "two fundamental phases," the egoistic, imperious phase, and the altruistic, adoptive phase, in which the emphasis is, in the one case, on the 'myself' and, in the other, on the 'other self.'

Perception is treated both as "mere idea" and as a social (sharing) experience of selves. Percepts are analyzed into sensational and relational elements, their history is given, and they are classified as "pure" and "mixed." As experience of selves, the perception's essential characteristic is said to be its social, 'altruistic' character; perceptions are 'public property.' This point seems to be forced. Does perception, even in the completed form of "my perception of an object," necessarily involve the like experience of others? The sharing is, surely, something external to the perceiving—however much social experience has figured in the *history* of the notion of external reality (*cf.* J. Royce, *Philos. Review*, III, 513)—and, moreover, it is the *object* that is shared, not the act of perceiving; the latter is as individual as imagination and memory which may, indeed, from one point of view, be said to be shared. For one of the first aims of art and of history is to extend participation in just these experiences. Although they have not a common, 'external' permanence in the world of sense, their objects and their functions are as truly—as much and as little—shared as are perceptions.

The chapter on perception would have been more satisfactory if the previous accounts of fusion and association had been more adequate. It is curious that illusions (defined as perceptions which do not "directly correspond with any outer object:" an extremely loose and ambiguous definition, by the way) are often 'pure' in distinction from 'mixed' (184); although pure perception "can occur only in primitive or in half-unconscious states" (180). Finally, it may be asked how this classification of perceptions can be fundamental, if peripherally and centrally excited sensations, on which the distinction rests, are the same in kind, as the author intimates (186-7).

In the treatment of memory, Miss Calkins follows Sully in the use of the term 'reproductive imagination.' The chapter is brief, pedagogical and jejune. There is nothing in it to tell the student what memory is, in terms of mind. It is worth noting that the *Introduction* deals, for the most part, with memory and imagination as functions of mind—the very terms are explicitly functional terms,—and yet makes one a subclass under the other. One would rather expect insistence on their essentially diverse functions (construction of a definite past and elaboration of a separate world of 'reality') and insistence on their ultimate likeness as contents-of-consciousness.

The two-fold treatment of thought (generalization, judgment and reasoning) is clear and extremely well carried through. In the analytical part, one cannot, however, avoid the feeling that the relational elements of 'generality' and of 'wholeness' are entirely overdone, and that they do not really supply the lack so woefully felt in all associationistic accounts of judgment and reasoning. The social character of thinking appears in its universality. "No man appropriates the multiplication table" or the axioms of Euclid. "Our thoughts are never regarded as personal property." "We do always in our thinking assume the conceivable universality of the experience, we acknowledge that other selves have, or may have, the concepts that we possess." Here, again, there seems to be a confusion of the 'universals' (a logical term) that are reached in generalization and a sharing of thoughts in a community of individuals. The 'anyness' of the general notion surely does not refer to 'any-thinking-body,' but to any-one-of-a-class. It is neither personal, psychological nor social, but epistemological. The triangularity of "any triangle" is scarcely "the part experienced by anybody who thinks of the triangle" (220); but the common mark of all things in a certain class. The social covenant is a subordinate and unessential feature of the concept.

The chapter on Recognition (XIX) deals chiefly with the 'feeling of familiarity,' which is found to be a 'relational experience,' further analyzable into the 'relational feelings' of 'same' and of 'past,' the latter "probably involving a feeling of linkage or connection" (260). Why not commit oneself unreservedly to the 'psychologist's fallacy' and push analysis to the phonetic elements of the words 'same' and 'past?'

"An emotion is defined as any complex fact of consciousness, of which pleasantness or unpleasantness is an important feature" (263). The taste of lemonade or the feeling of hunger, then? Even Sully's loose classification is more rigid, for it limits emotions to "*mental* feelings." There are two main types of emotion, those of happiness and those of unhappiness. The "ideas of bodily change" form a "secondary constituent of emotions." On the 'self' side, "emotion is the relation of individual with individual." Considered thus, emotion is either personal or impersonal (*i. e.*, it involves an attitude toward selves or things).[1] Either the social nature of the self (152) is not fundamental or this classification transcends the limits of a 'self' psychology.

The fundamental dualism of method which we have been observing works best in the realm of will and faith, where the self is, without doubt, thrust well into the foreground. Will and faith as the "relations of self to selves" (299) correspond, respectively, to volition and belief in idea-psychology. The treatment of these subjects is particularly well thought out. The general point of view is much like that of James. If the reviewer were to make any general criticism, it would be that will and faith, as active relations of selves, are too sharply set off from the 'passive' attitudes of emotion.

The chapters on Comparative Psychology give a brief and general statement of the facts of the animal and the child mind. The author is less at home here, depending largely on a few secondary sources; nevertheless, she writes clearly and comprehensively. An occasional slip is to be noticed. The invertebrates are said to have "no olfactory or gustatory organs" (357), although the end-organs of pressure, taste and smell are, we are told, developed before visual organs (357), and four types of eyes are found in invertebrates (361). In another place, the reader is gravely informed that fishes "have no brain, and therefore no olfactory lobe" (360). Again, certain statements are made broadly where fuller knowledge would have counselled caution; *e. g.*, "there is no doubt at all that the higher vertebrates and the insects possess sense-images, as well as sense-precepts" (365). And one can but look with suspicion upon a social consciousness that justifies itself by the animal heroisms of a Thompson-Seton.

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[1] "To quote Titchener, in emotion, the perception or image 'is swamped in the affection.'" I cannot verify the quotation, although I find the phrase "swamped by affection" (*Primer*, 1899, 141). Both the *Primer* (*loc. cit.*) and the *Outline*, 1899, 229, say very explicitly that the ideational unit in the emotion is not the perception or image but the assimilation; that the emotion demands a situation.

The sections on Abnormal Psychology furnish only a brief outline, but the point of view set forth is safe and conservative. The chapter does not show a wide knowledge of the literature. The author has reserved discussion of various difficult problems for the appendix. This helps the perspective and the proportions of the book and will, doubtless, be an aid to the junior student.

The reviewer's appreciation of the book in hand may be set down much more quickly than his adverse criticisms; not because it is given less freely or heartily than they, but because, quite on the contrary, it embraces the work as a whole, while they have dealt, for the most part, with minor particulars. The book is exceedingly good to read. The ease and directness of the style win one from the first page. It is, however, the vividness of presentation and the evident reality of the experiences discussed that will best serve the author's specific purpose. This is exceedingly important in an elementary text-book in psychology. The volume shows real psychological living, and it will help the student who comprehends it to find and to use psychological material in his own experience. Nearly every new topic is introduced by a concrete example which will start associations and make the topic significant. There is, moreover, a wealth of illustrations, chosen, as a rule, with care and discretion. The subordination of bare schemata and classifications is, in the writer's opinion, exceedingly wise. The attractiveness of psychological thinking can never be set before the youthful student by definitions and rubrications, however clear and logical these may be.

At the same time it cannot be denied that the *Introduction* is difficult. It has, quite often, the psychological world, apparently, more than the student, in view. The discussion of some problems, *e. g.*, the problem of attention, presupposes a knowledge of the subject well beyond the grasp of the elementary student. This mode of treatment may, however, be intentional, since the author believes that a text-book is a "subsidiary adjunct" in teaching science.[1]

I. M. BENTLEY.

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[1] The following minor points may be noted: Red, green, yellow and blue are said to be the elementary color qualities. Other colors are complex. "Yellow-green looks like yellow and green; that is, it is introspectively analyzable into yellow and green." But why not say, in the same way, that green looks like olive and peacock, and is therefore complex? Simple qualities can be similar and yet not be identical with each other. As a matter of fact, the author herself says: "green, for instance, appears to us like red and blue and yellow, but unlike sour and hot" (22). . . . . . The following statements are ambiguous. "The retina . . . . . terminating in the ciliary muscle." "The rods and cones, the only part of the eye on which the light can act directly" (24). "The ciliary muscle . . . . . whose contraction . . . . . enlarges the pupil" (24). With steady fixation straight ahead, a scarlet pencil when moved in "will seem gray or black until it is almost directly in front of my eye." . . . . . Some of the corners of fig. 4 are rounded and some are not. . . . . . The mucous membrane of the nasal cavity is said to be 'composed' of nerve fibres (63). . . . . . For the two-point limen, "no more probable or adequate hypothesis has been proposed than Weber's unstimulated nerve fibres (69). . . . . . Too great stress is laid upon relative temperatures of the body and surroundings in the production of warm and cold sensations (77). *Cf.* Ebbinghaus. Psychologie, 345-6, for adaptation. . . . . The "static sense of consciousness of

Grundzüge der Psychologie, von HERMANN EBINGHAUS. Veit & Comp., Leipzig, 1902. pp. 321-694.

We have here at last the second half of the writer's psychology. Although avowedly but an introduction, it is copious. The writer first treats of the soul, its concepts, names, organ, seat, relations to the body, and consciousness and unconsciousness. In the second book, the structure and function of the nervous system is given about 70 pages. The third book treats the simplest psychic forms, beginning with the eye and passing to hearing and the lower senses. It also treats sensations in their general laws, space, time, unity, threshold, and finally and very briefly, concepts, feeling and will, comprising about 300 pages. The fourth book, about 120 pages, is devoted to the general laws of psychic life, such as attention, memory, association, reproduction, habit, etc.

The Mental Functions of the Brain. An investigation into their localization and their manifestation in health and disease. By BERNARD HOLLANDER. G. P. Putnam's Sons, New York, 1901. pp. 507.

On the basis of the clinical records of eight hundred cases of localized brain derangements, this Freiburg physician attempts to reinstate phrenology. After a survey of the present state of mental science, he discusses first the pathology of melancholy with reference to the seat of the lesion in cases of injury, tumors, inflammatory disease, hemorrhage, symmetrical atrophy, cranial abnormality and psychic blindness. In the next chapters mania is treated in its various forms with suspicion, persecution, kleptomania, etc. Localization for words, number, color blindness, the centers of exaltation, mimicry, sympathy, veneration, and finally the cerebellum, are discussed, together with the relations between brain and skull and the significance of cranial contours, the doctrine of free will, etc. The history of the discoveries of Gall, Spurzheim and Combe are treated, and the disrepute of phrenology described to ignorant professionals. The opposition to phrenology by Spencer, Bastian, Flechsig, Minot, and especially Comte is treated, and finally testimony as to the truth and usefulness of phrenology by a score of medical men is adduced. A concluding chapter sums up the evidences as showing that the frontal lobe is the seat of the intellect, the parietal of the emotions, the temporal of the propensities, and the occipital of the affections. The all pervasive error of the work is the neglect of negative cases where the specific organ is morbidly affected without injury to the faculty there located.

Relation of Psychology to Music, by E. F. BARTHOLOMEW. Rock Island, Ill., 1899. pp. 310.

These lectures, originally given in thé Augustana Conservatory of

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the body's position (81) is a misleading phrase. . . . . On pp. 93-4 there is a confusion of clang-color and an alleged 'extensity' element in tones. A reference to Stumpf's treatment in the *Tonpsychologie* should clear up the matter. . . . . "It . . . . is very improbable that any cerebral distinction results from the slight difference of the retinal images" (99). Then how is stereoscopy possible? . . . . A bare statement of the "psycho-physic law" is given, without any reference to its significance. It is, however, difficult to see just what such a law can mean when applied to heterogenous "intensity elements" which are different for different sensations (111). . . . . Wundt is made to call affection an 'attribute' (114), without any reference to his most recent position (*cf. Grundriss*) which makes the affections separate elements.

Kraft Ebing is written for Krafft Ebing, Théodor for Theodule Ribot, Hanssen for Hansen, Nicholls for Nichols, Thomas for Anstruther-Thomson, Z. Stern for L. Stern. Taste buds are not confined to the circumvallate papilæ (v 58), but are to be found both on the anterior surface of the tongue and on the epiglottis. . . . . . "Other cells support the inner and outer 'organs of Corti'" (51). But the organ of Corti includes the rods of Corti, the inner and outer hair cells and the *lamina reticularis* (Schaefer).

Music, are by a man not well known in psychological circles, but evidently a deep soul thinker, whose treatment of the subject is often new and original, and always highly stimulating and suggestive. Under the means of musical expression, he treats of the nervous system, the eye, the range of hearing and listening. Other interesting chapters are on habit, association, memory, imagination, feelings and emotions. Not a few of his illustrations are interesting and original. This work represents the closest point of contact yet made between modern psychology and musical theory.

Saint Anselme, par DOMET DE VORGES. F. Alcan, Paris, 1901. pp. 334.

After characterizing the civilization of the eleventh century, science at the beginning of the Middle Ages, and the pre-scholastic schools, Anselme's life is briefly treated in twenty pages. Each of his works is then roughly outlined, and his theories of knowledge, truth, human nature, the soul, liberty, God and his famous proof of his existence, are concisely presented.

The Doctrine of Space and Time, by GEORGE S. FULLERTON. Reprinted from the *Philosophical Review*, Vol. X, Nos. 2, 3, 4, 5 and 6.

Professor Fullerton is now surely our best American authority on the philosophy of time and space. He has wrought into a clear consistent whole the views of previous thinkers with abundant and luminous suggestions of his own.

Chapters on English Metre, by JOSEPH B. MAYOR. University Press, Cambridge, 1901. pp. 308.

The chapters are as follows: introduction; antiquarian A-priorism logical A-priorism; æsthetic intuitiveism; natural or A-posteriori system; metrical metamorphosis; two recent metrical systems; naming and classification of metres, illustrations from Tennyson; naming and classification of metres, illustrations from the hymn-book; blank verse of Surrey and Marlowe; Shakespeare's blank verse—Macbeth; Shakespeare's blank verse- Hamlet; Modern blank verse—Tennyson and Browning; Shelley's metre; the English hexameter.

The Man Christ Jesus. A Life of Christ, by W. J. DAWSON. Grant Richards, London, 1901. pp. 454.

The author describes his object as "to depict the human life of Jesus as it appeared to his contemporaries with the purposed negligence, so far as is possible, of the vexed problems of theology and metaphysics." It is necessary to perpetually rewrite the life of Christ, because every age must speak a new language of religion. It is the only life in which the world is permanently interested. Although he began to write solely from the view of Jesus' human efficiency, this plan seemed taken out of his hands as he went on. It certainly brings many things very visibly and objectively before us, but this in almost exact proportion to the fidelity with which the author adhered to his original and pragmatic plan.

Die Kindheitsgeschichte Jesus nach Lucas, von JOHANNES HILLMAN. Jahrbücher für Protestantische Theologie, Vol. XVII, No. 2, pp. 192-257. Braunschweig, 1891.

This is the fullest digest of the whole story of the childhood of Jesus according to Luke, who tells it most fully, with an appendix on the way in which Luke treats the theme.

Die Analyse der Empfindungen und das Verhältniss des Physischen zum Psychischen, von E. MACH. Gustav Fischer, Jena, 1902. pp. 286.

It must have been twenty years since the author published the first pamphlet bearing this name. The third edition is much enlarged, both by additional topics and by supplements to those treated formerly. It is indeed such a standard and now so complete, that it is high time that it was done into good English.

Essai de psychologie militaire individuelle et collective, par M. CAMPEANO. Georges Fanchon, Paris, 1902. pp. 214.

After a preface by Ribot and a long premise on general and individual psychology, the will, attention, etc., the author proceeds to characterize the modern soldier; his relations to the army; the qualities of generals; the difference between infantry, cavalry and artillery; and finally discourses on the care of health in the service and military justice.

Experimental Sociology. Descriptive and Analytical. By FRANCES A. KELLOR. The Macmillan Co., New York, 1901. pp. 316.

This very helpful book describes—Elements of experimental criminal sociology; temporary laboratories and criminal characteristics; anthropometrical measurements; psychological tests; sociological data; suggestions for laboratories and child study; environment and criminality; the increase in criminality of women; penal and correctional institutions in the North; penal system in the South; defects in penal and correctional systems; relation of criminal sociology and criminal jurisprudence; suggestions for prevention of criminality.

The Nature and Development of Animal Intelligence, by WESLEY MILLS. T. Fisher Unwin, London, 1898. pp. 307.

The author has long been favorably known for his admirable studies on several species of young animals, but his papers have been widely scattered and inaccessible. This is by no means entirely a reprint, but while containing the best of his special studies it presents us his own wider view, and tells us how to study animal intelligence; the problems of comparative psychology; the functional development of the cerebral cortex in different groups of animals; somatic correlations with psychic development with special reference to the brain; and a final and interesting discussion on instinct.

Intuitive Suggestion. A new theory of the evolution of Mind. By J. W. THOMAS. Longmans, Green and Co., London, 1901. pp. 160.

Convinced that there are more missing links in the evolution of the mind than in that of the body, as well as great difference of opinion whether certain faculties could result from natural selection at all, this writer brings forth a new name, if not a new theory. He describes what he terms intuitive function in organic matter, then in the world of organization and life; treats of the relationship between the intuitive faculty and nerve action or mind; traces the development of the senses and the subsequent formation of the mind, the moral sense, and finally the intuitive functions as indicators of the coming time.

Neurological Technique, by IRVING HARDESTY. University Press, Chicago, 1902. pp. 183.

This work is designed as an introduction and laboratory guide to the study of the nervous system. It discusses the need and action of reagents; various methods like those of Nissl, Bethe, Apathy, Kupfer, Golgi, Weigert, Marchi and others; with special sections on the mode of treating embryos and a laboratory outline for dissection.

Capillaranalyse Beruhend auf Capillaritäts-und Adsorptionserschei ungen mit dem Schlusskapitel: das Emporsteigen der Farbstof in den Pflanzen, von FRIEDRICH GOPPELSROEDER. E. Birkhause Basel, 1901. pp. 545.

This volume with its tables, cuts and colored charts seems to be th most exhaustive study of the phenomena of capillarity absorption an the way and rate in which coloring material ascends in plants, ye made. Lists of colors of different substances with their action in different species of plants are almost ideally full and complete. We are unable to discuss it in detail, but it is a model of scientific researc which also has a wide field of practical application.

An X-Ray and Dissection of the Ureter and Utero-Ovarian Artery, by BYRON ROBINSON. Chicago.

A seven page pamphlet explains the utero-ovarian vascular circle, which was carefully dissected and photographed in two large chart which appear to be very carefully drawn, one of which is colored.

Altschwäbische Liebesbriefe, von ALBERT RITTER. Graz, 1898. pp. 118.

Das Geschlechtsleben der Heiligen, von F. STEINGIESSER. H. WALTHER, Berlin, 1902. pp. 64.

Das Geschlechtsleben des Weibes, von ANNA FISCHER-DÜCKELMANN. Hugo Bermühler, Berlin, 1902. pp. 219.

Experiments on the Effect of Muscular Work upon the Digestibility of Food and the Metabolism of Nitrogen conducted at the University of Tennessee 1897-99, by CHARLES E. WAIT. Govt. Print, Washington, 1901. pp. 77.

Thesis in Ontology or the Philosophy of Entity, by ARTHUR L. FROTHINGHAM. (2 parts, pp. 34.) Princeton, N. J.

We have perhaps in this country no one more devoted to ontology than the author of these pamphlets. From time to time he prints brochures at his own expense and sends them to those who are interested in these subjects for criticism and suggestion. While his terminology is somewhat difficult, it is plain that the author is very much at home in the literature, especially that of the mediæval period; and while perhaps no two thinkers in this field agree, all who ponder his questions will not only be interested, but stimulated.

The Theory of Prosperity, by SIMON N. PATTEN. The Macmillan Co., New York, 1902, pp. 237.

The first part discusses income as determined by existing conditions, including work and pay, monopoly, advantage, and investments. The second part treats of income as determined by heredity or more specifically as fixed by struggle; as increased by adjustment; as modi d by economic rights, whether those of leisure, society, of the arket, or exceptional rights.

thur Schopenhauer. Seine Persönlichkeit, seine Lehre, sein Glaube, von JOHANNES VOLKELT. E. Hauff, Stuttgart, 1900. pp. 392.

e have here an excellent picture of Schopenhauer—the man, his his work. The first is briefly told in twenty pages, and his per lity is characterized in twenty more; while to the motives that mpted him to his conclusions, his method, his theory of knowl e, his position in philosophy, his metaphysics, characterizations of world will and its objectivization, man as intellect and will, pes ism, genius, æsthetics, morals, pity, renunciation, significance of individual and of Schopenhauer himself, a chapter is given. irty pages of suggestive notes and a chronology of the author are ended.

THE AMERICAN

JOURNAL OF PSYCHOLOGY

Founded by G. STANLEY HALL in 1887.

Vol. XIII. APRIL, 1902. No. 2.

MENTAL LIFE OF TWO *MACACUS RHESUS* MONKEYS IN CAPTIVITY.—II.

By A. J. KINNAMAN, Fellow in Clark University.

NUMBER TESTS.

There has been considerable written and but very little done toward a rigorous examination of the number notions of lower animals. Stories of their wonderful achievements in counting and comprehending numerical relations are abundant. For example, it is said that shepherd dogs count sheep. One drove sheep to the wash in groups of ten each. Bird dogs are said to count the number of birds that fall when the master fires. One dog counts the railway stations when on a train, and so knows where to get off. Another displayed "thorough proficiency in the first four rules of arithmetic," barking off the answers of the problems put to him. A mouse came nine times to carry away each time one of her young handed to her from a cup, and did not return after the last was taken.[1] A Cincinnati mule counted fifty.[2] A dog counted her six puppies and knew when one was missing. Leroy reports a crow that counted four. One of the nearest approaches to real counting appears with some insects. A species of wasps, the Eumenès, supplies for its prospective young five victims for each egg laid. Other species with constancy supply ten, fifteen and twenty-four. When the regulation number has been put in the wasp stops even though some of the victims may have been stolen in the meantime. Again it is said that the Eumenes supplies for each male egg five and for each female egg ten victims. This looks very much like counting on the part of these insects. On the part of monkeys it is said that the larger apes will approach two or three men, but will not attack a larger number. Monkeys have been taught to hand up one, two and three marbles or straws when these numbers were called for.[1] Possibly all of the above cases were mere associations with quantity, and that the number idea as such was wholly absent.

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[1] Lindsay, Vol. I, p. 451.

[2] Weir: Dawn of Reason, p. 173.

I am not aware of any very systematic attempt to test the number sense in the lower animals. Mr. Garner made a few tests with monkeys, using marbles, from which he concluded that the monkeys knew clearly the difference between two and three. He presented two plates, on one of which were placed three cubes of carrot or other food; and on the other, one. The monkey tried to get the food from the plate containing the greater number. It is probable that quantity was more the basis of choice than number. Yet when one piece was increased in size the monkey still tried to get the two. Next he put three marbles into a box having a hole in one side of it. After the monkey had taken them out one at a time, for several times, he then put only two into the box. The monkey felt in the box, and then looked around where he had been sitting as if to find the missing marble. While Mr. Garner was well satisfied from these tests that the animal could distinguish number, these cases are easily explained on the basis of association and suggestion.

I was unable to make tests similar to Mr. Garner's with the *rhesus* monkeys because they were so wild and did not engage in play. I have tried to approach the question, however, in another way. I devised a special apparatus with which I made 2,790 tests with the male, 1,260 with the female, and 140 with two children. These, like the experiments of others, can hardly be said to test the ability to count or to comprehend number, but the reactions were so unique that it seems worth the while to report them rather fully.

The apparatus used consisted of a board 2½ inches wide and 10 feet long. Twenty-one uniform wide-mouthed bottles (or for the female, glasses) were set on the board four inches apart. The bodies of these bottles were covered with white paper to prevent food from being seen except from immediately above. In experimenting I set this board down at right angles [illegible] line from the monkey to the middle of the board, and th[illegible]ed back from three to six feet. After a few tests had [illegible] it became apparent that it would be most conven[illegible]ake one presentation in the south and one in the [illegible] of the room. The position of the apparatus varied

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Weir: Dawn of Reason, p. 177.

from time to time in each end of the room about ninety degrees in the angle of placing, and from a few inches to four or five feet forward and backward and from right to left.

The male was experimented with first. Food was put into the fourth bottle from each end of the board. By mere chance he first fell upon the food in the bottle on my right. In all the succeeding experiments only the right end of the board was used. The male was tested with eleven food bottles in the following order, counting from the end of the board to my right, 4, 2, 5, 1, 6, 9, 11, 8, 3, 10, and 7. In the accompanying table all above six are omitted, so the table gives the order 4, 2, 5, 1, 6, 3, which was the order followed with the female. The female was tested with no numbers higher than six. The numbers in the first column at the left indicate the numbers of the bottles or glasses used, counting from the end of the board to my right as I stood behind it. The numbers in the vertical columns following this indicate the number of times that each of these vessels was approached directly by the monkeys in a series of thirty tests. The number of times that vessels above the 7th were approached directly are thrown together in the table as "over 7." These tables take no account, again, of the bottles or glasses looked into after the one approached directly. The results from feeding the male in 7, 8, 9, 10 and 11 are not shown in the table.

The accuracy of selection could not be due to accidental markings on the vessels. For after accuracy was established I exchanged the food vessels for vessels taken from the other end of the board. These exchanges caused no apparent disturbance in the accuracy of choosing. It is interesting to note how gradually the burden of his choice swung up and down as the food was changed from one bottle to another. For example, I will give rather fully the changes when the male was fed from bottle 6. Note that he had been fed previously in 4, 2, 5, and 1. (1) In the first and second tests he went directly to 1, then examined all of the bottles up to 6. (2) With the third test he began going to 2 and 3, and then looking into the bottles back down to 1 and then up to 6. (3) With the 10th test he began going to 3 directly then to 2 and back to 6, thus neglecting the return to 1. (4) With the 16th trial he began going directly to 4, tracing down to 2 and back again to 6. (5) With the 27th trial he began going directly to 4, then looking into 3 and returning towards 6. (6) With the 42nd test he began with 4, and then took 5 and 6, leaving off all of the lower numbers. (7) With the 44th test, 5 was approached directly for the first time. (8) With the 53rd test he went directly to 6 for the first time. (9) With the 91st test he began choosing some numbers higher than 6.

There were, of course, numerous relapses after each one of the beginnings noted above. With the 90th test experimenting closed for the night. The next 30 tests show scattering choices as a result of the intermission. Bottle 1 was never chosen directly after the 9th test; 2, but once after the 13th test; and 3, but once after the 133rd test. The effects of these over-night intermissions are apparent in the table for the male. With food in 2 it appears in the seventh thirty; with the 5, in the fifth 30; with the 6, in the fourth 30; and with the 3, in the seventh 30. The over-night intermissions were avoided with the female.

One, two, five and six were definitely located, while three and four were always over-estimated. On the whole four was greatly over-estimated by the male. Only 22 times out of the 270 trials did he go directly to numbers below four, while he went directly to numbers above four 187 times, and directly to four 61 times. Three had 22 choices below it, 129 at and 149 above it. The apparatus was new for 4, while 3 was approached with considerable experience. Yet three had been preceded by feeding in 9, which would tend to induce over-estimating it. I was unable to note any irregularities in the condition of the animal or method of work that would account for the comparative failures with 3 and 4 followed by rather successful associations with 5 and 6. The choosing of 5 so often when I was feeding him from bottle 4 almost led one to believe that if the experimenting had begun with 5 instead of 4 he would have chosen it more frequently than he chose 4. Yet this is only a surmise. With 5 he selected lower numbers more frequently than higher ones. With 6 the former feeding bottle favored the selection of lower numbers. The table and the above analysis both show how he was affected by this fact. In all the higher numbers the choices fall mostly below the number of the food bottle. Thus, 7 was chosen 72 times with 8 choices over 7, and 220 choices under 7. Eight was chosen 127 times with 50 choices over 8 and 93 choices under 8. The choosing level was here lifted up by the fact that 11 had immediately preceded it. But the number of direct choices of 8 decreased, as did also the over-choices, as the experimenting progressed. Nine was chosen 25 times with 4 choices over 9 and 271 choices under 9. It had been preceded by 6. Ten, preceded by 3, had 1 direct choice, 2 over choices and 297 under choices. The [illegible] of choices for 10 fell with number 7, as it did also for [illegible] was preceded by 9. Its predecessor, [illegible] it than did that of 10. Eleven had 15 [illegible] choice and 194 under choices, while the [illegible] lies with 10. Four and five then seem to [illegible] his reaction to this apparatus. With 4

MALE

Numbers of Bottles	Food in Four									Food in Two										Food in Five						Food in One				Food in Six								Food in Three									
1	1												1															17	25	3												1		1		1	
2										1	3	5	9	9	3	1	1	23	25	4	1						5	12	5	5			1						1		2	6	3	1	2	1	3
3		1	4	2			7	5	2	10	14	14	12	16	22	7	19	7	5	8	9	6		2		12	22	1		17	7	5	4	3	1			1	8	9	13	15	14	13	20	17	19
4		5	5	6	6	9	8	12	10	10	8	10	5	5	5	19	9			8	16	15	7	13	5	13	2			5	17	7	16	6	2	2		4	11	11	12	8	13	12	6	9	8
5		10	10	7	15	15	8	9	12	4	5	1	3			1	1			7	1	8	18	13	20	5	1				5	15	7	10	8	12	3	7	7	9	3			2	1	2	
6	1	1	9	11	8	5	7	4	4	3						1				2	2	1	5	1	5						1	3	0	9	15	12	26	13	3	1				1	1		
7	3	6	1	4		1			1							1				1	1			1									1	2	4	3		2									
Over 7	25	7	1		1				1	2																							1			1	1	3									

FEMALE

Numbers of Glasses	Food in Four						Food in Two						Food in Five										Food in One			Food in Six										Food in Three						
1	6	3	1	1	1		3	8	5	1	4		2					1					1	11	25	2										1	1					
2	4	4	1	3	4	12	14	14	21	21	19	26	9	1		1	2	3	2	3	2			10	5	1										3	1	3	5	5	8	4
3	3	9	11	5	8	12	9	6	4	8	7	4	15	21	11	6	13	6	6	8	8	3	16	8		7						2			3	2	7	17	18	12	19	23
4	5	4	11	14	13	5	3	1					2	8	11	13	11	10	17	10	9	11	9	1		4		1			1	1	3	1	2	9	14	7	7	13	3	3
5	7	8	2	1	3	1	1						2		6	8	3	7	3	8	9	12	3			5	5	3	1	1	4	3	3	5	5	13	5	3				
6	2		4	3	1			1							2	2	1	2	2	1	2	4	1			2	6	6	7	8	7	10	10	12	14	1	1					
7		1		1																						7	9	4	8	12	8	9	7	9	4	1						
Over 7	3	1		1														1								2	10	16	14	9	10	5	5	3	2		1					

and lower numbers he inclined to choose higher numbers than the food bottle; above 4, lower numbers were chosen. While numbers were learned up to six, 3 and 4 were beset with special difficulties. Three was more definitely recognized than 4. One and 2 gave comparatively little difficulty, and in the case of 4 it may be that the confusion arose out of the fact that it was near this turning point of approach.

With the female the tables of results show less capacity than with the male, but a more ready association for the numbers that she was able to comprehend. Thus, when the food was in 1, the male chose correctly only 17 times in the third group of 30 tests, while the female chose correctly 25 times. He chose two three times in the sixth thirty; she chose it 26 times; he chose three 13 times in the seventh 30; she 23 times. So far she chose better than he did. Above 3 his superiority for the number idea, if indeed it be number, is very apparent. He chose four 9 times in the sixth thirty; she chose it only 5 times. He chose five 20 times in the the sixth 30; she only 7 times. He chose six 26 times in the eighth 30; she 11 times. It was thought unnecessary to try her further. Five was as difficult for her as seven for him. She learned no number above three with any degree of certainty. The male learned six as perfectly as the female learned three. His central number space from which he appeared to work down to a lower and up to higher numbers was between four and five, hers was between three and four. But she introduced a variation with six. Here she cast most of her choices above the food glass. Thus with her 1, 2 and 3 are apparently numbered, or at least recognized definitely. Four and five are quantities just to be estimated. With the male 1, 2, 3 (4?), 5 and 6 are definitely recognized numbers, while all beyond these are an indefinite great many. We may conclude that these two animals with this apparatus were able to recognize numbers from 1 to 3 and from 1 to 6 respectively.

Two children, aged 3 and 5, who had not been taught to count, were brought before this apparatus under conditions as nearly as possible the same as those for the monkey. Marbles were used instead of food. The older child located 1, 2 and 3 perfectly, but could not make sure of higher numbers. It is possible that he could have succeeded with others if experiments could have been continued without fatigue. The monkeys apparently never fatigued no matter how long the experimenting was continued. This child early resorted to noting the spatial location of the glass containing the marble, and attempted to return to that place in the room. He was not allowed to take the marble unless he came directly to the glass containing it, but in case he missed it he was allowed to look along the row of glasses and to see in what glass the marble was to be found. As he returned to his mother at the other side of the room the apparatus was shifted to a new position. When he began trying to locate the glass in this way he was told that the apparatus would be moved, and arrangements were made for sliding it over on to a second table. The three year old child learned 1 and 2 perfectly. Three was more difficult, and the child failed with larger numbers. Thus the monkeys appear in this particular to attain in one year to a development attained by human beings in from three to five years. But here monkeys ability to comprehend numbers and number relations probably reaches its limit, while the human being goes on not only to a comprehension of larger numbers but learns to deal with numbers both abstractly and symbolically.

But what is it that the monkey and children recognize here? Is it number, quantity or form? Lubbock would have it that in all such cases as mentioned at the beginning of this section, which closely resembles those with the monkeys and children the animal does not have a number idea, but an impression of greater or less quantity. It could hardly be maintained that these monkeys and children counted the glasses or bottles in order to determine which one contained food. With the larger numbers clearly selected one could see the eyes of the monkey give a quick movement along the line. The movements were not those of stops and starts. Roughly estimating I should say that the glance did not occupy more than one-fourth of a second. The appearance was merely that of sizing up of the quantity. Ribot[1] seems to express the process exactly when he is discussing Leroy's report of the crow. He says: "I see here not a numeration but a perception of plurality, which is something quite different." Of this process he adds, "it is a preliminary state, an introduction, nothing more, and the animal does not pass beyond this stage, does not count in the exact sense of the word."

Lloyd Morgan[2] has dealt definitely with the case in hand. He says: "The raw materials of numerical relations, as of those of space and time, are given in our daily experience, and are marginally sensed long before they are focally perceived. The child, long before he can count, senses the difference between one thing and two things, between two and three, between three and several, between several and many. It would not be surprising to find that a clever dog was able to distinguish from each other playing-cards, from the ace to the ten. But they would be distinguished through difference of sense-impression, not through perception of numerical relations. So, too, with succession. One can very readily distinguish a succession of three from a succession of four, without anything like counting, through the sensing of sense-experience. It is, indeed, surprising how large a group of sounds, up to sixty-four in my own case, can be appreciated without counting. But the perception of numerical relations is something more than the sensing of a group of discrete objects or sounds. It is also to be distinguished from the perception of the group as larger or smaller. Whether the numerical relations were first perceived among objects simultaneously presented, or in association with succession, we cannot say; but it is at least possible, if not probable, that they arose in close association with that phase of time-experience which presents us with succession rather than duration. Run the eye slowly from left to right along the shaded diagram. You are subconsciously aware of the duration of the impression it produces. But if you run the eye along the second figure you are aware of succession.

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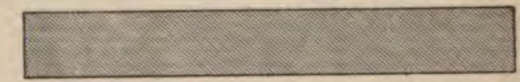
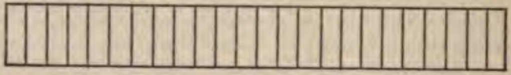
[1] Evolution of General Ideas, Chicago, 1899, p. 21.

[2] Introduction to Comparative Psychology, London, 1900, p. 232.





The homogenous duration of a continuous impression gives place to a successive series of similar impressions. And in this series you have not only one aspect of time-sequence, but also the material form from which a numerical-sequence may, on the advent of reflection, be evolved." This appears to be what the monkeys and children did in their reactions to this apparatus. The numbers 1, 2 and 3 were clearly discriminated, while 4, 5 and 6 were seen as a somewhat definite mass. Beyond these we have only an indefinite mass or group but no measured quantity.

REACTION TO A MAZE.

The maze used was identical in form with that used by Dr. Willard Small[1] and I am indebted to him for the use of the accompanying cut. My maze was, however, of necessity much larger than his, being 17 feet long, 13 feet wide and 14 inches high. The alleys were 1 foot wide. The whole was built of "chicken wire" fastened to wooden frames. The central por-

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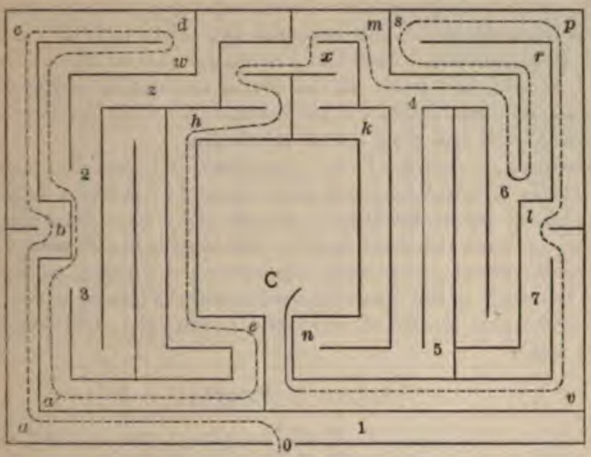
[1] *American Journal of Psychology*, Vol. XII, Jan., 1901, p. 207.



tion was not covered, so that when the animal procured his food, which was put in the middle of this central portion, he was free from the maze and could return to his cage. The entrance was at *o*. Numbers 1-7 indicate the blind alleys. The dotted line shows the most direct course through the maze.

The sources of error, on the part of the animals, were the blind alleys and return movements along the direct course. In keeping the records, entrance into a blind alley was always called an error. Also, if the animal proceeded to any point in the direct course, then returned any distance in this course, turned about and proceeded correctly thereafter, he was recorded as having made one mistake no matter how great the return movement. If, for example, he proceeded to 3 and returned to *a*, this was counted as one error. If he entered 3 and returned to *a* this counted for two errors, one for entrance into the blind alley and one for failure to take up the proper course as he came out of it. Entrance at 4 was arbitrarily counted as an error, while a trip through *xkn* was not so regarded as that merely represented a longer course to the goal than proceeding by way of *m*. The shortest path from the entrance to the food was 105 feet, and there were 27 corners to be turned.

Method.

After the cage had been brought up to the entrance of the maze, the monkey was allowed to see some food placed on the floor in the middle of the open center. The door of the cage was then lifted. The monkey invariably rushed at once into the maze. Printed forms, identical with the accompanying cut, were used for keeping the record of movements, while the time was kept with a stop-watch. I took up my position behind the cage and opposite *o*. This brought the maze in full view, and allowed the monkey to see me from any part of it. While he moved I traced his path on the forms indicating stops and the number of seconds required to reach any given portion of the maze along with the time spent in resting.

As soon as the animal had procured his food the cage was turned partly around and the door opened. After a few times he learned to go immediately across the maze into the cage, even while I held the door open. On beginning it was decided to regard the maze as learned whenever the animal succeded in passing through it ten times consecutively without error. The male reached this standard with the 113th trip, and the female with the 66th.

Analysis of Results.

In their native habitat these monkeys are accustomed to weaving their way through the boughs of trees and along winding paths of the bamboo thickets.[1] Their native haunts in a very general way at least are like the maze. They showed no fright at being confined in it and my presence near the maze (I was about ten feet from it) did not seem to annoy them in the least.

In the first tests if a blind alley was entered it was pursued to the end. Then the monkey seized the wire and shook it, looked about awhile and returned. Later when alleys were entered there was no shaking. He either sat as if trying to determine his proper course or turned about quickly and came away. After an alley had been entered several times it was pursued only a short distance. They were entered and left at about the same speed. The hasty glance, when blocked in an alley, followed by the return movement, gave the animal very much the appearance of saying "Hold up! No, that 's wrong. Well, I 'll go back."

In the accompanying table the figures in the first horizontal line indicate the number of the trips through the maze. Twenty trips for each animal are shown. The items in the n at the left will be readily understood by reference to eceding cut.

uccessful passing of a blind alley (4 has been counted a blind alley) is indicated by leaving the space blank.

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ng says in his Jungle Book, p. 57, that the flight of the Monle through tree-land is one of the things nobody can describe. e their regular roads and cross-roads, up hills and down laid out from fifty to seventy or one hundred feet above nd by these they can travel even at night if necessary. This correct description of their habits.

	MALE																				FEMALE																			
Parts of the Maze, etc.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Entered Blind Alley 1	4		5	1	5	1	2	3	1	1					1			1	1		4	3					1	1	1	1										
a, Passed	12		12	2	8	2	4	4	4	2		2			2			2	2		8	18					2		2	1	2									
b, Passed	12		8	2	10	2	6	4	4	2		2			2			2	2		8	24					2	2	2		2									
c, Passed	10	2	6	2	8	2	6	4	4	2		2			2			2	2		8	22		2			2	2			2									
w, Passed	16	4			6	4	6	4				2			2			2			2	14		2																
Entered Blind Alley 2	8							2													1	5		2			1	1						1		1	1	1	1	
Entered Blind Alley 3	11	2	1			1	1											1			2	8		1		2	1	1				1		1						
e, Passed	2	4			6	2	6	2		2												24	2	2	2	2								2						
e h, Traversed	30	12		1	16	4	8	2		2	2										2	30	2	2	2	4														
x, Entered		3		2	5	1	3	1													1	13																		
kn, Traversed	2	16	3	5	23	3	7	2									2				7	30			1															
Entered Blind Alley 4		2	1	2	3			1	1	1	1		1	1		1	1				1	11	1	2	2	1	1													
" " " 5		3		1	3		1							1			1				1	5	2		1	1														
" " " 6	6		1	1			1		1	1	1	2	3	2	1	1	2	1	1	1	1	4	1	1	1	2	1	1	2	1	1	1								
r, Passed	6						2				2	2	6	2								4	2	2					2											
p, Passed	2				2		2									2					2	2	2																	
Entered Blind Alley 7	2						1	2				1				1					2	1	1																	
To v and Return	1				1																																			
Times in Seconds	2700	1800	420	180	900	230	300	226	160	204	107	100	88	61	67	43	69	30	66	41	3300	7620	840	420	375	450	210	195	165	135	250	154	76	104	45	175	94	116	158	54
Errors	56	32	15	8	32	6	15	11	4	6	3	4	4	4	2	3	4	4	2	1	23	76	9	11	5	7	5	5	3	3	2	2	0	4	0	1	1	2	1	0

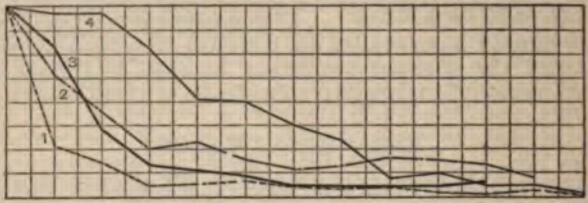
The figures indicate the number of times that any point was passed or any alley was entered by way of error. Some short return movements between the letters on the cut could not be presented in this table. Also many return movements along the direct course passed several of the points designated. Hence, often the total number of errors given near the bottom of the table does not agree with the items of error in the body of the table. It will be seen that the errors decreased very rapidly after the second trial, and that the female was the slower at first, but surpassed the male in her fifth trip. For her first trips she required the longer time, but he made more than twice as many errors as she did. His movements were much more rapid than hers, and she spent by far the greater amount of time sitting around with folded hands.

Alleys 1 and 6 persisted longest, while 2, 5 and especially 7 were soon eliminated. Yet relapses sometimes set in where a part had been passed successfully a great many times. The table shows that the male learned the last part of the maze first, but suffered considerable relapses with the 11th, 12th, 13th and 14th trips. The middle part was well learned in the tenth trip, while in the first part of the maze serious relapses occurred after the 12th. With the female we find the same order, but the parts were mastered more readily. In her 13th trip she went through without error, but the male did not meet with similar success until his 36th trip.

Comparing the two in the accompanying table of average times and errors it appears that the female has accomplished much more than the male. She learned the maze in 66 trials, while he required 113. His movements being much faster than hers he attained to an average time of 44.8 seconds, while her average never went lower than 55. But when in the maze neither ever went faster than a brisk walk or "dog trot," though, as with Mr. Small's rats, this gait was hastened toward the last of the journey. The increase in speed, however, was not very great, and was rarely begun until after *p* was passed. When the latter part of the maze was fairly learned, the monkeys often after passing *r* would begin to smack their lips audibly, apparently at the thought of the food. In their earlier trials as they passed from *e* to *h* they stopped to look at the food, and often attempted to reach it, but after the first few trials no effort was made at shaking the wire or reaching, and often they did not even look toward it.

The feeling of uncertainty manifested itself with the male at *m* and 4. Coming from *n* up through 4 he would not turn toward the exit, but would proceed to *m* and then face about and continue correctly. The male repeated this movement ten times. The female showed signs of similar indecision by half body-length movements into 3, 4 and 6, and three times by turning completely around when passing 4. Often there was a mere hesitancy at 4 before continuing the trip. On entering the maze the first time the animal's first move was to get nearer trips through the maze. Curve (4) is based on the errors committed on the first ten presentations in the tests in colors, forms, and numbers. Twenty-two groups of ten tests were used. The simple fastenings and the maze, curves (1) and (2), after the second trip, are very similar. Curves (2) and (4), (combination locks and colors, etc.), for the first ten tests are very irregular, but strangely enough happen to run along somewhat together.

Curves of Learning. These curves represent the complete learning process. Curve (1), as in the previous set of curves, is based on seventeen locks, etc., these locks were practically learned in 13 trials. Curve (2) is based on the times of the monkeys with combination lock 1, which was learned by them, and on the first 120 tests with the male with combination lock 2. This was included in the calculation because he had practically learned the combination at that point. These tests were divided into consecutive groups of ten each and the per cents computed as before. In this and the two succeeding curves the consecutive groups are indicated by the alternate dividing lines along the abscissa. Curve (3) is based similarly on the time required for learning the maze. Curve (4) was obtained by dividing the tests for 12 of the forms, sizes and numbers into consecutive groups of ten each counting errors and then computing the per cents as before. In this were used only those series where the association was fairly well established within the 130 tests. Each point then in curve (4) is based on 120 tests and must be regarded as fairly reliable. The similarity of the first, second and third curves is very striking. The elevation of (4), especially at its second and third points, over that of the other curves is probably due to the fact that in a large per cent. of these tests there was first an old and conflicting association to be broken up before the new one could be begun. Progress in the new association would not set in until after 30 tests had been made. Beyond that point the curve is not very unlike the others, however; it shows the same gradual improvement in the associations. While the first few tests with different kinds of apparatus show very different results, as may be seen in the first set of curves, the curves of learning by trial



are rather uniform. Clearly then the first ten or twelve tests cannot be regarded as showing the curve of learning since the results with these vary considerable, not only with the animals but also with the apparatus used. A far better notion of the progress of learning is to be gotten from curves representing results from the first tests to comparative mastery.

The maze, it seems to me, offers no new problem above that of working a combination lock or associating food with one of a series of glasses by number, form or color. The number of trials required for attaining comparative mastery is much the same for each. In the learning process we have here again a more or less definitely directed effort spurred by the food stimulus, fortunate accidents, memory of them and the elimination of useless efforts. Thus blind alleys are cut off, return movements are omitted, the shaking of the maze is dropped, as the path and method of getting the food gradually become fixed upon the monkey's mind. The maze tests, therefore, throw no new light on the general problem of the monkeys' intelligence or method of learning. They confirm the results of the preceding tests, however, and in a general way make an interesting point of connection with Dr. Small's admirable work on rats.

MEMORY.

Memory tests were made three times with the male and twice with the female. The tests were made at regular intervals of fifty days each. The combination locks and maze were used. Each monkey was given ten trials with each apparatus. Probably a comparison of the times for manipulating the locks and going through the maze with the original learning times will give the best notion of the results. The errors run almost parallel with the times, and so, need not be presented.

The first series of memory tests, show reactions shorter than the first ten trials of the original learning, but longer than the last ten trials. The average time required for manipulating each piece of apparatus for the first memory series was about equal to that of the ten trials at the end of the first third of the original learning series. But when the male was taken through these tests after a second space of fifty days he showed a decidedly greater loss than he had shown at the end of the first period, as is to be seen in the table. The female in her second series of memory tests showed a decided improvement, not only in the time required but in her manner of attack, especially in the maze. There she acted precisely as if she knew quite well just how to go through. She made but few errors, and none at all in the last half of the maze. The male, however, by his hesitations, return movements and entrance into the blind al-

		AVERAGE TIME FOR LEARNING. (In seconds.)			AVERAGE TIME FOR MEMORY TESTS. (In Seconds.)		
	APPARATUS.	First Ten Tests	Last Ten Tests	Tests with time nearly equal to memory time	First Series	Second Series	Third Series
MALE.	1st Combination Lock.	34.0	6.4	4th ten 14.4	13.7	22.7	15.6
	2nd Combination Lock.	105.3	13.6	6th ten 27.0	28.1	44.3	66.2
	Maze.	726.9	59.5	2nd ten 73.7	88.3	110.6	157.1
FEMALE.	1st Combination Lock.	89.8	5.1	5th ten 16.2	14.2	10.8	
	2nd Combination Lock.	101.1	19.6	5th ten 32.5	31.0	17.9	
	Maze.	2579.0	55.0	2nd ten 127.7	120.0	44.5	

leys, showed unmistakable signs of confusion, which in his third memory series was still more apparent. In this series he moved less rapidly than in his previous tests, while the female showed herself unusually enthusiastic and increased her originally slow gait considerably, so that while she had formerly required 45 seconds as her minimum time for passing through the maze, she now did it in two separate trials in 31 seconds each. He formerly went through in 39 seconds, but now required 84.

In his third and her second memory series they had been without food the same length of time, and were practically equally hungry. Yet one showed some loss and the other considerable gains over the preceding memory tests and even over the best results in the original learning. It is impossible to say that the monkeys have been equally hungry in all of the tests reported in this paper. Probably they have not been, though every care was taken to have them so. Again, practically nothing is known of just how progressive hunger affects the mental capabilities of animals. All absolute time and error results may have been partly determined, however, by this varying factor of hunger.

In none of these cases is the memory perfect; that is to say, the animal's execution of these tasks was not as good as on the last trials in the original series. Usually the first memory trial took a comparatively long time and resulted in a large number of errors, but the one trial apparently revived the former images so well that the second trial compares favorably with trials after considerable practice in the original series. This memory, probably, is of the type commonly designated as *associative memory* and does not differ in its essential character from the associative act involved when the manipulation of a piece of apparatus was first being learned. In all such cases the sight of A lead to the expectation of B. If B was imaged, it was done immediately after the presentation of A to the senses. It is possible that B was never recalled between tests however far they may have been separated; it did not recur until the immediate preceding presentation was at hand. In the darkness of his cell the monkey *may* recall in trains of images how objects look, recall something that he did on the preceding day, or may image the special dainty dish on which he dined yesterday or a week ago, but if he does, the fact of such a process can never be known until he learns to introspect and can be taught to write or speak, and that can never be done.

Memory tests with simple apparatus can have but very little value if experimenting has gone on in similar lines between the times of the original and memory tests. It was shown in our tests with simple locks that the horizontal hook which had not been learned at first was worked very quickly several days later, simply because there had been some general improvement in the meantime in dealing with that modality of apparatus. With such apparatus, if experimenting has intervened, an animal might appear to remember very accurately over an interval of fifty days, when in reality his success was due to general improvement rather than to excellence of memory. When there has been no intervening experimenting of any kind it appears that we ought to get better data in case of the animal than we could get with a human subject. It is probable that the animal never recalls the experiment or the apparatus from the time of the original experiment until the memory test is made. With the human being it is quite impossible to avoid the intermediary recalls so that in such cases we do not get a test of the pure permanence of an association based upon a given number of trials in so perfect a form as we get it with the animal. Unfortunately we have as yet no memory tests with animals similar to these reported here, so far as I know, with which to compare them in determining the relative excellence of the monkey's memory.[1]

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[1] One of the best experimental studies of the human memory yet made is that by Ebbinghaus Ueber das Gedächtnis, Leipzig, 1885. Summaries appear in James's Psychol., Vol. I, p. 676, and in the *Amer. Jour. of Psy.*, Vol. II, pp. 587-603. Ebbinghaus found that after a month

of smell was the basis of choice this movement away from the food should not have continued all the way up to 6, and the glasses should not have been *looked* into with so great care.

When making the tests for discrimination of grays (second control test in the section on color discriminating) with the two glasses, both glasses had been used hundreds of times for feeding, yet where the shades were very different the monkey chose correctly almost every time. If he had been dependent upon odor for his choice he should have discriminated between glasses widely different no better than between those differing but very little in shade. But we have seen that choosing improved regularly as the difference between the shades was increased. In the experiments with designs where the shaded glasses were finally substituted for the designs the glass colored black had had food in it only a few times, yet the monkey sometimes chose black even though the food was in the lighter from which he had been fed many times, and my hand containing some food was nearer the food glass. Again in all the experiments with glasses and bottles the male only once put his nose to the neck of a bottle as if to smell for the food, and that may have been only an accidental position and no real effort to smell out the location of the food. The female never appealed in this way to the sense of smell.

These inferences and the general impression left upon the observer, both enforce the conclusion that the sense of smell was by no means acute in these animals, and that they relied in all of their choices to a vastly preponderating degree, if not exclusively, upon the sense of sight.

INDIVIDUAL DIFFERENCES.

The individual differences between the two monkeys are very great. Many of them have been pointed out from time to time in former sections, and it only remains to draw them all together here.

The female is the older by some four or five months. She is larger and covered with more and longer hair. This is especially true of the face and brows, and gives her a more repulsive visage. The eyes and nose vary according to age as they do in the human family. With the young the bridge of the nose is low and broad and the eyes seem to stand far apart, but with the adult the nose becomes more prominent and the eyes seem to lie proportionally closer together. I received the female one month later than the male. This has made her appear at times less like the male than she really is: her earlier reactions to the laboratory environment being set side by side with his later ones. Dated notes along with tabular results, however, served to control this tendency.

The male is more timid than the female. I attribute it to the fact that he is less rugged than she. He has been ill twice, but has managed to regain his health. When ill he was unusually nervous. Owing to his nervousness he reacts quicker to any sudden noise, and "flies to pieces" before he has time to see the cause of the disturbance. When I approach the cage in which they are kept the female sits on the perch nearer the front of the cage. The male sits behind her or springs wildly about the back part of the cage. When out in the room together she will approach nearer than the male, and is bolder in her efforts to snatch food. The male is swifter in his movements than the female. When I desire to separate them I have only to open the door of the cage. He rushes out and there is plenty of time to close the door before she reaches it. When moving about the room from table to window, from window to sink and back to the large case or to the cage he is nearly always in the lead. When they climb a tree together he is in the lead both in going up and coming down. She does not run but shambles off in an awkward sidewise manner.

The interest shown in each other is worthy of mention. The male more frequently makes the request to be picked. If the female is put into the cage and taken out into the hallway he is much concerned and climbs the gas pipes and springs to the transom to see if she is near. Then he gives the call, in fact, repeats it often. He looks frightened and stops frequently to listen for her. But if *he* is taken out she settles down deliberately to business and shows no disturbance at his absence except occasionally to answer his calls.

In the earlier experiences she was the head of the family. But she exercised this family presidency on but few occasions, once with a significant stroke more vigorous than a caress, which, however, missed the mark, and again in a scramble for a vantage point in which he was worsted.

Since publishing the first part of this paper in which it was stated that the female was master, the male has begun to assert his rights. He now allows her to sit in front and reach for food, but then takes it from her, and pushes her off the perch. She makes no effort to regain the food, but patiently sits below and eats what he lets fall.

If several pieces of bread are tossed into the cage the male seizes one or two and proceeds to fill his cheek pouches. The female takes one in each hand and pulls others up near her as her own. I have seen her with one or two pieces near her and at the same time with a piece in each foot and a piece in each hand and another in her mouth. Her greed far surpasses his. She is more filthy in her habits than he, very frequently lapping her urine and even eating her excrement. He rarely has done the former, and never the latter, though he certainly was as hungry as she. But neither has any idea or spirit of cleanliness.

In their reaction to the locks the male moved more rapidly about the boxes. He tried more persistently, and gave up only after many fruitless efforts. Thus on the horizontal hook he was less discouraged at the end of 17 minutes of trials than she at the end of 100 seconds. She required to be helped by having food placed on the parts to be moved, and did not at last substitute a better method of turning the lock after it had been learned. The male sometimes opened a lock a few times with his teeth and then substituted the hand. If the lock was tried with the hand and that failed the teeth were applied. He would try to work a fastening by moving it; she tried to chew it up or to break the strings with her teeth. She always seemed stupid in beginning, but often came suddenly to the idea, and finally, if it was an easy thing, learned it more quickly than he. Thus the first combination lock was learned by her in 80 trials, while the male required 253, but the amount of time required for the first manipulation, generally, is decidedly in favor of the male. With the second and more difficult combination lock she is far his inferior as the tables show. In all of the very difficult things he appeared to be superior, but for the easy things she was superior.

If we turn to the association with forms the reactions are very much alike. When the forms were set down the male sometimes rushed up quickly looking behind him, both right and left, as if frightened. He seemed scarcely to give more than a furtive glance at the forms. But the female shambled up in a slow wabble going straight to the point for which she started. After a series of experiments with the male, if there was perfect quiet, he became more composed and settled down strictly to business, but his nervousness and swiftness of movement will in part account for his greater irregularity after a thing was fairly well learned. Little noises sometimes veered him to right or left from his objective point. With the size boxes both showed a tendency to select larger rather than smaller boxes.

The female learned colors more readily than the male. For the most part this appeared to be due either to a clearer color perception or to greater associative capacity, but in part also to the fact that she approached more slowly, thus giving herself time to survey the line of glasses more carefully, while the male at times was so anxious and quick of movement that he rather took what he ran against. When he was inclined to do this I would hold the board until I saw him glance along it and then set it down.

When making these experiments it was necessary to take a minute to rearrange the glasses and put the food in. In the meantime the male would sit near by flea hunting or with his hands crossed, waiting for his next morsel. The female, however, would run to a distance and sit down. On coming again to the board she would walk or slowly shamble up, killing a great deal of time. Or, perchance, she would climb into one of the oak trees and get a dry leaf to eat. If the board were set down just as she got the leaf she would usually munch the whole of it before starting for the food in the glass. Sometimes, however, she carried the leaf with her.

As to color preference it has been shown that the male preferred yellow, orange and green, while the female fell to taking the food in regular order, and thus defeated the purpose of the experiment. When put into the box with colored illumination the male tried to escape, but the female spent her time in sitting about apparently in inquiry and wonder.

The individual differences in reaction to the number tests have been quite fully set forth in the section on number. In sum, it may be said that with the lower numbers she made the association more readily than he, but that he continued the associations up to six, while she stopped with three. In the reactions to the maze she required longer times at first and never went through in so short a time as he did, except in her second memory test, but she learned the maze with only about half as many trials as he required. The individual differences are apparently as great as they might be expected to be in two human beings selected at random. The assumption of some anthropologists that the lower animals of a given class react in practically the same way to the same environment can only hold with animals of this grade in the most general sense.

IMITATION.

In this section I want briefly to set forth what seems to me a reasonable conception of imitation and to bring forward the cases observed, to be evaluated according to the criteria presented, and this the more, because Dr. Thorndike, in experimenting with his monkeys, found no cases of imitation. If one declares, even after any amount of careful observation and experimentation, *without definition*, that an animal does not imitate, does not generalize, or does not reason, his declaration has on that account but little value. Again, if he defines these terms only in their highest forms of human activity, and then declares that the animal has not attained to them, his declaration has a certain value, but it gives only a limited view of the animal's activity. It merely states what the animal does not do. It amounts to a mere negation and nothing more. The processes of imitation, generalization and reasoning, about which there is so much contention in animal psychology, all manifest themselves in the human being in more than one form. There are higher and lower forms. It is reasonable to suppose that animals will not present the highest forms, but that some of them will at least show something of the lower and preliminary forms. Such indeed is the necessary assumption, if we are to believe that the human mind is derived in unbroken series by increasing complication of factors found in the simplest animal reactions. Let us examine some of the classifications of imitative reactions.

Lloyd Morgan[1] classifies the imitative activities as instinctive and intelligent. Below these he places mimicry. On the latter point he says:[2] "Passing reference may here be made to those instinctive actions for which *mimicry* is now a recognized biological term. Certain distasteful butterflies, for example, are mimicked by others, which are believed to have escaped destruction because of their mimetic resemblance to the others. There is no intentional imitation. The mimicry is purely of objective significance. And not only in form, but also in their instinctive behavior, are many of these insects, and perhaps some birds, mimetic of others. Such behavior is, from the purely objective point of view, imitative. But since there does not seem to be any good ground for supposing that the mimetic behavior is called forth by the stimulus of such behavior in the models, it does not fall under the head of instinctive imitation we are considering. By using the term 'mimetic' in its biological signification, we may mark off these cases in mimicry in behavior from true examples of instinctive imitation—that is to say, instinctive behavior called forth by similar behavior in others."

By *instinctive imitation* is to be understood "the congenitally automatic behavior, which from the observer's standpoint, is imitative." "It is an organic response independent of experience." This phase appears to be identical with Baldwin's organic imitation.[3] In such cases there stands an instinct ready to be called into action by its appropriate stimulus. The newly hatched chick will give a warning signal at the sight of some threatening object. His action is purely instinctive. Another chick, not seeing the object, will take up the refrain and will repeat the signal. Thus, though the usual or perhaps appropriate stimulus for setting off that instinctive action, with the second chick, is wanting it takes the warning signal of the other chick as its cue. Hence, from the observer's point of view, chick No. 2 imitates chick No. 1, but in reality his behavior was only an automatic response. For further illustrations of this phase of imitation see Lloyd Morgan's Habit and Instinct, p. 166. Apparently the instance presented by Dr. Thorndike, Animal Intelligence, p. 48, can be explained in this way. The first members of a flock of sheep, as they were driven along, were compelled to jump over a hurdle. Then the hurdle was removed, but several sheep immediately following sprang up as if to clear the bar. The sight of the leap in one, induced reflexively, similar action in the one succeeding. Objectively it looks like imitation, but subjectively it is automatic behavior.

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[1] Habit and Instinct, p. 174.

[2] Habit and Instinct, p. 169.

[3] Mental Development, p. 263.

True imitation implies an action or a result to be copied, and a certain amount of preliminary experience, is due to conscious guidance, and is based upon the immediate satisfaction which accompanies the act of imitation itself. When a child is to trace a curve the "preliminary experience" consists in the previously "acquired data in the light of which control over his arm and finger movements may be exercised." "In the case of the curve, the child first imitates the action—holds the pencil and moves the fingers in certain definite ways. But as soon as passable results are reached, it is on this, and not on the movements, that he fixes his attention. His object is no longer to imitate the action, so much as to reproduce the copy."

Again, imitations have been classed as simple and persistent.[1] "By *simple imitations*, reactions are characterized, in which the movement does not really imitate, but is the best the child can do. He does not try to improve, by making a second attempt." By *persistent imitation* is meant the child's effort, by repetition, to improve his imitations.

In a word then we have:—

1. *Mimicry*, which lies below the level of imitation.
2. *Instinctive imitation*, or automatic behavior.
3. Intelligent imitation.
   a. Of actions.
   b. Of results.

Two special forms have been described:—

(1) *Simple*, consisting of single efforts, but with no succeeding attempts with a view to improvement.

(2) *Persistent*, consisting of several attempts at improvement.

If I am asked whether these two monkeys have imitated, the answer must be divided. Corresponding to the *mimicry*, described above, we have the instinctive crouching, simulating the crouching of the feline tribes of animals. (See General Observations.) So far as these animals are concerned they spring upon nothing. The crouching simulates the action of an animal which does crouch and spring. But the crouching is used by these only as a bluff, and certainly with no notion of imitating those animals or its fellows. And indeed it does appear threatening, but a wave of the hand or a square look into his face changes bravery into precipitate flight. I am not informed as to whether the adult *rhesus* ever crouches and actually springs upon his prey, but these young ones have shown no sign of doing so.

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[1] Baldwin's Mental Development, p. 132.

Instinctive imitation, or automatic behavior, was observed frequently when the monkeys were in separate cages. When one could not see the other, if either gave the danger signal, or the food signal, the other immediately repeated it. The similarity to the action of the chicks described by Morgan is so close that no further discussion is necessary.

Again, of the simple form as discussed by Baldwin, I observed one very clear case. The male looked under the bottom of one of the trees that stood in the room. This required that he should put his face clear down onto the floor. Immediately afterwards the female took a peep in exactly the same way. She did this but once. This appears to me to come clearly under Morgan's class of intelligent imitation of an act. Of course the female did not set out deliberately to repeat the act simply for the sake of the act. But seeing that he did thus and so she voluntarily and not reflexively repeated the act to satisfy her curiosity or in the hope of getting food, though the male had gotten no food as a reward for his act. There were many other cases of this type, as it seems to me, though they are more difficult to demonstrate. The difficulty arises out of the fact that the actions may have complex motives. As, for example, if the male springs upon the table or into a window, or climbs a tree, the female follows suit. Does she imitate his act? Possibly she does. Possibly she is actuated by the same motives as he, and being the slower of movement is a little behind him. This gives her the appearance of imitating. My belief is that having once clearly demonstrated that she could imitate, we are safe when evaluating such cases as the above in assuming that she responds to a complex motive of which imitation is probably a part. Some of the other motives are fright, feeding and flight, and the social instincts.

But again I have observed two cases of imitation of the *persistent* and *intelligent* types. These have already been described at length. (See Simple Locks, Methods of Learning.) Here we have a copy in the form of an act. It was copied almost in detail, and that, too, so far as the place of laying hold of the plug and the direction of the pull were concerned, both requiring very radical changes from the monkeys' own previous efforts. Further, the copy was repeatedly followed and fashioned into a well-defined habit.

Then, have the monkeys imitated? Neither have imitated any of my acts so far as I am aware. The male has rarely ever done anything that could be regarded as an imitation of the actions of the female. The female, however, has imitated the male, manifesting every phase of the process as defined above.

GENERAL NOTIONS.

I can do no better here than to follow the general plan of the preceding section.

Romanes[1] used the word *Idea* as a generic term to signify, "indifferently, any product of imagination, from the mere memory of a sensuous impression up to the result of the most abstruse generalization."

"By *Simple Idea*, *Particular Idea* or *Concrete Idea*, I understand the mere memory of a particular sensuous perception.

"By *Compound Idea*, *Complex Idea*, or *Mixed Idea*, I understand the combination of simple, particular, or concrete ideas into that kind of composite idea which is possible without the aid of language. [Called by Romanes a recept.]

"Lastly, by *General Idea*, *Abstract Idea*, *Concept*, or *Notion*, I understand that kind of composite idea which is rendered possible only by the aid of language, or by the process of naming abstractions as abstractions."

One may not be inclined to accept the name here applied by Romanes, yet psychologists accept some such phenomena in mental life as the basis of naming. (Ribot and James.) The particular images, or ideas, are of the nature of mental images, or memories of such and such objects, as the sound of a voice or the image of a particular horse. If there is such a thing as a general idea, it must arise out of particular ideas, as when we get the general idea, horse, from observing numerous horses. His second and third classes above would include eneral ideas. The third class (barring discussion of the probems of nominalism, idealism, and the notion of the "rule" "schema" as designated by the general terms of language) presents the higher human generalizations.

Ribot names three classes of general notions above and beond the pure individual representations, the first named by omanes.

1. *Abstraction and generalization* with no possible aid from

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Mental Evolution in Man, 1899, p. 34.

language. These are called *generic images* by Huxley, Galton and Ribot. They are the same as Romanes's "recepts," and are intermediate between the pure image on one hand the generalizations on the other.[1]

2. *Intermediate abstraction.* These imply the use of words. "At their lowest stage they can hardly rise above the level of the generic image; they can be reduced to a vague schema, in which the word is almost a superfluous accompaniment. At a stage higher the parts are inverted; the representative schema becomes more and more impoverished, and is obliterated by the word, which rises in consciousness to the first rank."

3. *Higher Concepts.* These can no longer be imaged. This is the characteristically human form where everything is subordinated to language.[2]

In brief form we have then:

1. Individual representations, concrete ideas, pure images. This class is offered not as a kind of generic image, but as lying just below the level of generic images, and yet closely allied to them.

2. Generic images, or recepts, compound idea, complex idea, mixed idea, abstraction and generalization with no possible aid from language.

3. Intermediate abstraction.

4. Higher concepts, general idea, abstract idea, concept, notion.

Accepting the above classification we are ready to ask whether the monkeys have given any unmistakable signs of having any of these classes of ideas.

It may be doubtful whether the monkeys have "free ideas," that is whether they do call up the image of anything not now present to the senses. Do their minds as they sit quietly on their perch play with images and scenes from other times and places? It is probably impossible to know that they either do or do not have such images. Those committed to the law of parsimony, can say in truth, that it is possible at least to reduce all seeming manifestations of such free images to lower terms; while those not so committed can say with equal justice that the same may be said of human behavior also, and with the monkeys we observe such objective phenomena as in the human being are the regular accompaniments of free ideas. Such acts as the efforts to enter the box for food, smacking the lips while passing through the maze, climbing the gas pipes and springing to the transom to see the mate that had been caged and removed to the hall, and other similar acts are, to say the least, very like what human beings do when calling up images of objects and persons not present to the senses. These are fairly good signs of our first class, particular images.

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[1] See, also, James, Vol. II, p. 46-48.

[2] Evolution of General Ideas, pp. 10 and 88.

As to the generic images not requiring the use of language it seems to me that three very favorable cases have arisen, two of which bear some of the ear-marks of the still higher form regarded by Ribot as *intermediate abstraction*. The first case is that presented in the third section of Methods of Learning. It seems to me that the only reasonable way to explain how the monkey came at last to single out and attack a fastener at a new place on the door, immediately on coming up to it, while in the earlier tests he tried almost anywhere, is to say that he developed some sort of a general notion of a localized hindrance. The fact of projection above the surface of the box would appear to be the only general quality of these fasteners, though the plugs and levers had more in common than all the other fasteners had, such as being made of wood, projecting rather far, having a rigid appearance, etc. It seems quite probable at least that some such notion arose and served as a starting point in singling out from the total complex of a box with door, holes, edges, lights and shadows the objective point for attack. No control tests were made, however, to verify such a general notion in this case.

The case described under the second control test in discrimination of color and shade seems to be a fairly good one and represents a tolerably high degree of abstraction. The generic image, if such it was, was that of a darker and a lighter glass with food in the lighter. This image was then modified to fit the new conditions whatever they might be. There was one clear alternative, namely: the monkey's æsthetic taste, or an instinctive feeding preference for lighter over darker forms, may have been so strong as to draw him always to the lighter forms. But the tests with designs, where the food was put into the darker glass, contradict such a supposition. I undertook by the same method as that employed in the tests with designs to change the male's feeding habit to the darker glass. But the old habit established by 3,200 tests proved to be so strong that it would have required several hundred tests to change it. So I used the female. Four hundred tests were made with her, feeding in the darker glass. These sufficed to show clearly that she would establish as strong a feeding habit, if not a stronger, with the darker as the male did with the lighter form.

Still a third case was noticed, and is reported under the fourth control test on discriminations of color and shade. Referring to the tables there we see that when the blue glass with its three corresponding grays was presented, the male in the first thirty chose correctly 17 times, and the female 13 times. When the yellow was next presented with its grays the correct choices in the first thirty tests were 12 for the male and 27 for the female. With the red the figures are, 26 for the male, 24 for the female. When the green was reached the corresponding numbers rose to 28 and 30 respectively. This difference becomes more striking if we compare the first ten tests of each color instead of the first thirty, since it shows better how abruptly the correct choosing came in. The correct choices in the first ten tests of the male, for the blue, yellow, red and green respectively were, 2, 2, 8 and 8; the female's were, 5, 8, 8 and 10. Why this improvement as we change from one color to another? Is it because the green and its grays are distinguished better than the blue and its grays? The next table, the tests for which were made some days later, would indicate no such difference in favor of the green. Besides now the blue is chosen out from among its grays, practically as well as is the green from its grays, and the choices of yellow with the male have risen now to an equality with the others.

Then do we have here a general notion to be represented perhaps by "food-always-in-the-odd-glass?" If so we might substitute one red and three blues or a gray of one shade and three grays of another shade and still get from twenty-five to thirty correct choices out of thirty tests. But when this was done they immediately dropped to from three to ten correct choices out of thirty. Clearly, then, this was not the general notion in the mind of the monkey. But suppose we should say that the notion was such as could be represented by the formula "food-in-the-colored-glass." This seems more plausible. The notion has risen from extreme vagueness to almost perfect clearness. Now the reaction to all colored glasses or to all grays as before is all confusion and is just what we might expect from an adult human being if we were to place three blue and one red, or three dark and one light gray glasses in a room and tell him to bring us the colored one. He would look them over several times and then bring all or none.

But there are yet two possible alternatives for avoiding the idea of a general notion here. The monkeys had been fed from colored glasses on this board before; they then would be expected to go to the colored glasses instead of the grays. But they were fed from grays when the six grays were used in the control test, and that came after the feeding from colored glasses. Besides this the male started out in the first of these tests going to the grays five times as often as to the blue though there were only three times as many grays as blues. The female, however, went at once to the blue half as often as to the grays. Clearly that alternative will not explain the readiness for selecting the colored glasses as the ones most liable to contain

Therefore . . . .

The syllogistic *forms* in cases of perception are really entirely wanting. From a psychological point of view they are not to be reckoned with, though *logical analysis* may find such processes implied. Where the process of perception is very slow, recognition, identification and verification, the implied logical forms, may rise very nearly to explicit logical forms. But while such analysis may have pedagogical significance, it has no psychological importance, and the matter is here mentioned only to be excluded. They are at most but cases of *implied reasoning*.

Unconscious or immediate inference ranks next in order. A good description of it is found in James.[1] It occurs "where a present sign suggests an unseen, distant, or future reality. Where the sign and what it suggests are both *concretes which have been coupled together on previous occasions*, the inference is common to both brutes and men, being really nothing more than association by contiguity. A and B, dinner-bell and dinner, have been experienced in immediate succession. Hence A no sooner falls upon the sense than B is anticipated, and steps are taken to meet it. The whole education of our domestic beasts, all the cunning added by age and experience to wild ones, and the greater part of our human knowingness consists in the ability to make a mass of inferences of this simplest sort. Our 'perceptions,' or recognitions of what objects are before us, are inferences of this kind. We feel a patch of color, and we say 'a distant house;' a whiff of odor crosses us, and we say 'a skunk;' a faint sound is heard, and we call it a railroad train. Examples are needless; for such inferences of sensations not presented form the staple and tissue of our perceptive life, and our Chapter XIX was full of them, illusory or veracious. They have been called unconscious inferences. Certainly we are commonly unconscious that we are inferring at all. The sign and signified melt into what seems to us the object of a single pulse of thought. Immediate inferences would be a good name for these simple acts of reasoning requiring but two terms, were it not that formal logic has already appropriated the expression for a more technical use."

Ribot describes what appears to be the same as *immediate inference* under the caption, "Inference from particular to particular," under *Logic of Images*. His other subdivision is "Procedure by analogy."

"1. *Inference from particular to particular*. The bird which finds bread upon the window, one morning, comes back next day at the same hour, finds it again, and continues to come.

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[1] James, Vol. II, p. 326.

It is moved by an association of images, plus the state of awaiting, of anticipation as described above.

"2. *Procedure by analogy*. This (at least in its higher forms in animal intelligence) presupposes mental construction; the aim is definite, and means to attain it are invented. To this type I should refer the cases cited above of ants digging tunnels, forming bridges, etc. The ants are wont to practice these operations in their normal life; their virtue lies in the power of disassociation from their habitual conditions, from their familiar ant-heap, and of adaptation to new and unknown cases."[1]

It seems to me that there should be recognized a phase of reasoning somewhat lower than the preceding, and in a general way very like that described by James as "rational thinking," in that it consists of a train of images, but different in that it is connected immediately with perception and action. To illustrate, one desires to reach a certain point on the side of his house. He stands near by and looks over the situation. He now sees that an attempt to go up over the window would fail. He looks at his step-ladder near by, but that is too short. But he notes that he can get on to a low roof from this ladder, pass along to the right and reach the desired point. Free this process from the immediate presentations and we have James's "rational thinking," which in its more purposive forms becomes the predominant process of the inventor. But so long as it is mainly for purposes of action and consists in thinking of one's self in new attitudes and positions within the perceptual field it may with propriety be designated as *adaptive intelligence*, and is of about the same grade of rationality as analogical reasoning which has not yet reached full consciousness and verbal expression.

James's description of "rational thinking" is brief, and I quote it in full.

"Much of our thinking consists of trains of images one suggested by another, or a sort of spontaneous revery of which it seems likely enough that the higher brutes should be capable. This sort of thinking leads nevertheless to rational conclusions, both practical and theoretical. The links between the terms are either 'contiguity' or 'similarity,' and with a mixture of both of these things we can hardly be incoherent. As a rule, in this sort of irresponsible thinking, the terms which fall to be coupled together are empirical concretes, not abstractions. A sunset may call up the vessel's deck from which I saw one last summer, the companions of my voyage, my arrival into port, etc.; or it may make me think of solar myths, of Hercules's and Hector's funeral pyres, of Homer and whether he could write, of the Greek alphabet, etc. If habitual contiguities predominate we have a prosaic mind; if rare contiguities, or similarities, have free play, we call the person fanciful, poetic or witty. But the thought as a rule is of matters taken in their entirety. Having been thinking of one, we find later that we are thinking of another, to which we have been lifted along, we hardly know how. If an abstract quality figures in the procession, it arrests our attention but for a moment, and fades into something else, and is never very abstract. Thus, in thinking of the sun-myths, we may have a gleam of admiration at the gracefulness of the primitive human mind, or a moment of disgust at the narrowness of modern interpreters. But, in the main, we think less of qualities than of whole things, real or possible, just as we may experience them.

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[1] Evolution of General Ideas, p. 26.

"The upshot of it may be that we are reminded of some practical duty; we write a letter to a friend abroad, or we take down the lexicon and study our Greek lesson. Our thought is rational, and leads to a rational act, but it can hardly be called reasoning in a strict sense of the term."[1]

Finally there is the more formal type which consists in associating two ideas through the mediation of a third.[2] It is the "substitution of parts and their implications or consequences for wholes."

The pure *logic* of reasoning must, however, be kept distinct from the practical or psychological process. The latter involves, according to James (Vol. II, p. 340), first an act of sagacity in extracting from a total complex presentation some character which is then taken as an equivalent to the entire datum from which it comes, and second an advance from this to certain suggested consequences more obviously seen in it than in the total datum as originally presented.

Enumerating briefly we have:—

1. Implicit reasoning. (Harris.)
2. Inference from particular to particular. (Ribot.) Unconscious or immediate inference. (James.)
3. Adaptive intelligence.
4. Analogy.
5. Rational thinking. (James.)
6. Formal reasoning.

The first is present with these animals quite as much as with human beings. There can be no doubt that the monkeys recognize kinds of food and other objects of familiar classes, and it is as fair to apply logical analysis to this process in them as to like processes in human beings. But this is not, from the standpoint of psychology, in any sense a reasoning process either in men or animals.

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[1] James, *op. cit.*, Vol. I, p. 325.
[2] James, *op. cit.*, Vol. II, p. 330.

Cases of reasoning by immediate inference, as James calls it, are numerous. When they saw the box used in experimenting, and although they had just then seen no food put into it, the sight of the box suggested the idea of food and the box was opened. When in the maze certain parts well on toward the end suggested the food and the lips were smacked. Seeing me the food signals were given. Seeing the sink suggests the idea of water in a pan just out of sight, and the sink is climbed for water. Here we have Ribot's "state of expectation," an anticipation, but it is expectation based on the fact that in a previous experience the present percept was followed by the thing now expected to follow. It is a case in which we have two terms associated, but have the mind occupied less with the memory of the past than with the expectation of the term to follow.

The adaptive intelligence, which is hardly reasoning, was well illustrated on one occasion when I tied a piece of apple to the tip end of a limb of one of the trees. This was a strong, long limb, the last four or five feet of which extended along the ceiling. The monkey's weight on this limb could not bend it down. He watched me as I tied the apple fast. Then he rushed up the tree nearly to the place where it brushed the ceiling. He was baffled, and returned part way down the tree, after which he passed out another limb and looked the field over for a full minute. The position was changed and the field scanned over again. Then he went up the tree to the ceiling, swung himself under the limb and went along it hand-over-hand until the apple could be reached. Here the thinking is that of tracing out a line of conduct, planning a campaign and then executing it. It probably consists in putting in consecutive order, somewhat imperfectly, a series of percepts as a guide to future activity. One might wonder whether he did not in his joints, tendons and hands feel himself making the journey. This looks very much like a capability for analyzing a situation. So does the case already reported where the monkey sprang from the corner of the table to the large post and grabbed a pear as he went. But such a capacity apparently neither Mr. Thorndike nor Mr. Morgan will grant.[1]

Whether their processes rise to the fourth level becomes a more difficult problem. Do these monkeys recognize similarity? Do they, in working the latches for example, have a dim consciousness that this projection is like the one whose pulling gave the [illegible] then come to feel that pulling this ought to do the same thing. This, of course, we cannot positively determine. Earlier in the paper and again in the preceding section it was reported that the monkey in his first tests on locked-boxes attacked no specific part of the box, and later invariably attacked the fastener even though it was of a new form and at a new place. Thus, when the push bar was put into the right side of the box no other fastener had been put on the box near where it was placed, except a plug, for several series of tests preceding. It had been preceded by a string, ring and nail on the front, by a latch at the left and front, and by a string in the rear of the box. But when the box with the new latch was set before him he rushed by the front and attacked the pusher immediately. One of two things, he either recognized the similarity of this pusher to other fasteners though it was similar to the others only in being a projecting thing, and to the plugs, levers and lift-latches in being a wooden projection, and concluded that working it would bring food; or, the pull at that point was a mere reflex from the sight of the projecting latch itself, a sort of acquired tropism by which he was attracted to the latches in general. With the first four fastenings the monkey began and opened each several times by mere accident. It took time to discover the latches themselves. But when the fifth was presented, the door bolt, it was attacked directly and moved in one second. Thereafter, with a single exception, the locks were attacked directly and no energy or time was wasted in trials anywhere else about the box.

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[1] Na [illegible]

I am inclined to think that in such cases as this there is a complex state of mind, involving partly the reflex from the sight of the object, and partly the recognition of similarity, along with the food idea, and possibly several other minor factors.

Morgan and Thorndike both insist that animals cannot reason by analogy. However true this may be of chicks, cats and dogs, I very much doubt whether it is true of *rhesus* monkeys. The ruling out of reasoning by analogy with all lower animals, it seems to me, is often due to a failure to differentiate sufficiently the psychological process of analogical reasoning, resulting in practical activity, from a subsequent logical analysis, accounting for the intelligent act. Of course the animals cannot do the latter. In part their reasoning is like that of the human being. Yesterday a man saw a vine and handled it without evil results. To-day he sees another quite like it, handles it and is poisoned. He does not say "Lo, now, here is this and this likeness, therefore it is safe to handle this vine." He was just dimly conscious of a resemblance. He may not possibly be able to name a single likeness if put to the test. So far in his process he and the monkey have gone along together. But just here they part company. You ask the man why he handled this poisonous vine. Now he furnishes you a logical analysis, a reasoning by analogy, a subsequent explanation of his conduct, more or less definite according to his powers of observation. He says, "Why the thing looked just like the vine I handled the day before, and I never thought of its poisoning me, or I thought it would not poison me." In other words he gives explicitly what was implied in his previous act. From the standpoint of logic he reasons analogically in a process parallel with the analogy implied in his previous act.

Mr. Morgan makes this distinction very clearly in his Introduction to Comparative Psychology, pp. 279-283. He regards what I have here called the psychological process, as "a sequence of an impression, and an idea in sense-experience without implying either perception or conception," and calls it *intelligent inference* in the field of sense-experience. He, apparently, would regard the process as of a kind with our (2) and (3) above (Inference from particular to particular, and Adaptive intelligence). Further, he would say that the logical process is in no wise implied in the psychological, but only the relations on which the logical is afterwards based. He says, by way of conclusion, that he wishes to use the word "intelligence" for the faculty in virtue of which inferences are suggested in the field of sense-experience, and "reason," where the logical relation is *clearly* perceived. Every one, I presume, would grant at once that most cases of apparant implied analogical reasoning, may be nothing more than association, immediate inference or adaptive intelligence; but my position is that some cases, such as that of the latches, where the "prophetic" phase is present quite prominently, may come under Mr. Morgan's implied category of *less clearly perceived*, and yet be reasoning by analogy. The real question is, of course, that of fixing the degree of "clearness" required for analogical reasoning. As a matter of fact the lower forms pass into the higher by imperceptible gradations not to be fixed by hard and fast definitions.

All of the lower forms of reasoning, and forms of activity antecedent to reasoning are usually granted to the lower animals, unless it be that of James's rational thinking, which is hardly to be reckoned as reasoning, but more nearly perhaps as reverie. The field of greatest contention is at the level of analogical reasoning. As to the still higher forms of human reasoning it has often been asserted that animals have employed them, but n [illegible] I know, by any psychologist of acknowle [illegible]

RÉSUMÉ.

We have seen that these monkeys have indulged in movements signifying emotions such as fright, anger, social feeling, disappointment, curiosity and surprise. The emotional range has been very limited however. There has been no friendly spirit manifested towards the keeper or towards any one else. But the desire for the company of their fellows has been shown frequently by the loud calls when they were separated. There has been no mischievousness nor destructiveness simply for the sake of those activities. Nothing has been destroyed or injured except in attempts to escape and to procure food. The instinctive fear of snakes and cats is present. But frogs and newts merely surprised. There has been no manifestation of play such as springing about the cage or running after each other in sport. The mutual flea-hunt is their only amusement, if indeed it can be called such. Several sounds have been used signifying food, danger, loneliness, anger and disappointment, but these are not words, only very general instinctive responses.

The monkeys have learned to manipulate simple and complex locks and allied apparatus. In doing so they have made a little progress in capability for choosing better methods of working, inhibiting useless acts, and employing short circuiting processes. We have seen how the formation of a third association of three similar but opposing ones resulted in a partial recall of the first, and that it is more difficult to break one association and then form a new, than to form one *de novo.* (See experiments with forms.) We have found several cases of imitation, one being of very high order. We have found evidence, also, of general notions and reasoning, both of a low order. It has been shown that the monkeys associate food with forms more readily than with sizes and colors. In the choosing of sizes they erred in favor of larger forms, whether the sizes were arranged in an arithmetical or geometrical progression. They certainly are able to distinguish colors as colors and not merely as shades of gray. As regards color-preference it can be said at most only that it is probable that they like yellow, orange and green better than red, purple, blue and gray. They were able to do no real counting, but position in a series of objects was recognized by one as far as 3 and by the other as far as 6. Their general intelligence appears to be high, if we compare the time curves determined by Mr. Thorndike with cats, dogs and chicks. Human beings have not greatly surpassed them in some respects when dealing with the apparatus here used. In many of the experiments we have reported the errors made by the animals. It often happens that the errors are more important in the animals' processes than are the time results.

The sort of errors made, the elimination of many unnecessary movements and the character of many other reactions not classified here incline the writer to believe that the monkey's mental processes are after all not so simple as analysts have often asserted them to be. Whether these animals have "free ideas" and general notions beyond the mere 'recept,' and are capable of real analogical reasoning cannot be positively determined. If they do, the processes certainly do not rise to the level of full reflective consciousness. Yet there is no way of knowing, because there is no certain way of having the consciousness that the animal has. But that these monkeys have often acted objectively just as human beings act when they have these mental activities is most certain. I am inclined to believe that the human and animal consciousnesses are not really different in kind but only in degree; the difference in degree, however, is very great.

APPENDIX.

It is my design to furnish in this section a brief study of the *Macacus rhesus* monkey such as I have been able to extract from the literature of the subject.

The Bhunder or *Macacus rhesus* is the Bandar of the Hindus, and is to be found all over Northern India. It is a very strong looking animal when full grown. The body of the adult is from fifty to sixty-five centimeters long. The tail is about one-third as long as the body. The body is large and thick in front and tapers backward. The limbs and shoulders are very strong. The prevailing color of the hair is olive-green and brown on the back, and a dull white underneath. The face, ears, hands and seat-pads vary with age from a pale flesh-color to a light copper color. With age the face and callosities often become very red.

The whole appearance is so baboon-like that Cuvier,[1] Shaw and Audibert classified them as baboons. In Cassell's Natural History, edited by P. Martin Duncan, New York, 1884, they are classified as dog-shaped monkeys, while Brehm classes them in the same family with the Dril and Mandril, neither of which is ever classed as anything except a baboon. The Royal Natural History, edited by Richard Lydekker, London and New York, 1893-94, Vol. I, p. 113, discusses the Bhunder (*Macacus rhesus*) under the heading, "The Bengal Monkey."

While they are thus classed as one of the lowest of the monkeys or as a good baboon they are invariably regarded as having a high degree of intelligence.

They inhabit a great portion of the inlands of India, and are found continuously northward from the valley of the Godaver to the Himalaya, extending to the west coast at Bombay. Great numbers live in the valley of the Ganges, and some are to be met with in the warmer valleys of the Himalayas. They have been seen in the neighborhood of Kasmir at an elevation of 4,000 feet, and near the sanitarium of Simla at an elevation between 8 or 9,000 feet above sea-level. Hutton reports that he saw these monkeys there in February when the snow was from ten to fifteen centimeters deep. They slept at night upon the trees and were apparently oblivious to the cold. They were, however, more stupid than when the weather was warmer. The monkeys were more abundant in winter than in summer in the vicinity of Simla. At times they were seen springing and playing under the pine trees whose boughs were covered with snow.

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[1] The Animal Kingdom, Cuvier, London, 1827. Vol. I, p. 289.

Near Simla is a hill called Jako. A fakir lives here who regularly calls the monkeys and feeds them. No one has properly done Simla who has not walked or ridden out to see the monkeys fed.

In Bengal the Bhunder lives in great numbers. They like the forests,where they are invariably found. Usually they rove about in great droves. They often go into the plains and cultivated fields, and not unfrequently, even into the towns and cities. Crooke[1] says " The *rhesus* is a most troublesome, mischievous beast, and does enormous mischief to crops, while in cities he is little short of a pest. But his life is protected, by a most effective sanction, and no one dares to injure him." These monkeys are probably never regarded as sacred, though they are protected, and tithes are left in the fields for their benefit. In places they form " part and parcel of the appendages of the temples." There is strong objection to killing these monkeys, probably partly due to the general belief that no one can live where a monkey has been killed. A monkey's bones are exceedingly unlucky.

They delight in the small streams, and are good swimmers and can dive successfully, apparently coming out at the landing previously chosen. When wild these monkeys make a hideous noise with their calling and chattering. They eat large quantities of fruits and seeds, and do a great deal of digging for insects and spiders.

They are docile and easily taught if captured and trained while young, and are much used by fakirs and in shows. They are favorites with trainers for they learn their tricks easily and work at them with great endurance and skill. In captivity, in their happier moods, they join with their fellows in the "flea-hunt," but are liable to fall out at any time and go on the war path. In youth they may be affectionate toward their fellows and their keepers, but as adults they occasionally like their fellows but always hate human beings. The trainer may make them submissive, but they cannot drive all of the treachery out of them. When they go into a rage they break, tear up or destroy whatever they can lay hands on. If free to do so at such times they will attack a man fearlessly, using their powerful teeth with great skill and force. They are constantly threatening and bluffing at every one who approaches near the cage. They open their mouths, the eyes bat and they set their bodies into a crouching position like that of beasts of prey. Then they whet the teeth, puff out the cheeks and bob part way up as if just starting to spring upon one. Yet unless greatly annoyed they would in reality run away if they had half a chance. Lydekker reports an instance where a gentleman came across a party of these monkeys, among whom were several females with young ones. He undertook to run them down in order to capture one of the young. The old males deliberately charged upon him, and he was compelled to shoot the leader in order to make good his escape.

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[1] Popular Religion and Folk-Lore of Northern India, 1896, Vol. I, p. 88.

In captivity they are ill-tempered, jealous, selfish and tyrannical. When males are caged together they are very quarrelsome, so keepers prefer to cage a male and female together.

Lydekker repeats a story from Prof. Bell, who says, "When at Malwa Tal (near the Himalayan Station of Naini Tal), which is one of the lakes where I spent a day, I was warned that, in passing under a landslip which slopes down to the lake, I should be liable to have stones thrown at me by the monkeys. Regarding this as being possibly a traveller's tale, I made a particular point of going to the spot in order to see what could have given rise to it. As I approached the base of the landslip on the north side of the lake, I saw a number of brown monkeys (*M. rhesus*) rush to the sides and across the top of the slip, and presently pieces of loosened stone and shale came tumbling down near where I stood. I fully satisfied myself that this was not merely accidental; for I distinctly saw one monkey industriously, with both forepaws, and with obvious malice of pretense, pushing the loose shingle off a shoulder of rock. I then tried the effect of throwing stones at them, and this made them quite angry, and the number of fragments which they then set rolling was speedily doubled. This, though it does not actually amount to throwing or projecting an object by monkeys as a means of offence, comes very near to the same thing, and makes me think that there may be truth in the stories of their throwing fruit at people from trees."

In some parts of India they are left very much to themselves; so they assemble in troops, and steal from among the natives in a very troublesome manner.

As they are bold, their habits in the wild state are often observable, their slyness and thieving propensities being most amusing. They gather on the roofs of the low houses in the bazaars, and look out for occasion to steal.[1]

In conclusion, I translate from Brehm, p. 134, Cuvier's report of his observations of a mother Bhunder and her baby born in captivity.

"Immediately after birth the young *rhesus* climbed upon the belly of the mother, meanwhile he held firmly to the fur with his four hands, and took the nipple in his mouth, and did not release it for fifteen days. He remained during the entire time in an unchanged position, always engaged in sleeping and sucking. He released one nipple only that he might seize the other. And so he passed the first days of his life making motions only with his lips for sucking and his eyes for seeing. Like all monkeys he was born with his eyes open, and it appeared that from the first moment he could distinguish his environment, for he followed all moving objects with movements of the eyes.

"It cannot be reported, how great the anxiety of the mother was, and how much she was concerned with the sucking and security of her new-born baby. She showed herself often so intelligent and cautious that one wondered at her. The least noise, the gentlest movement eliciting her attention, and anxious care for her young, not for herself; for she had lived with men and had become perfectly tame. All her motions took place with the greatest dexterity, and yet never in such a way that the suckling suffered any. The weight of the young appeared to hinder none of the mother's movements, and made no difference in her activity and bluster. However, it was significant that the mother took double care not to strike her young against anything. After about fourteen days the young began to release himself from his mother and to run about, showing an astonishing strength and dexterity considering that he had had neither previous practice nor experience. The young *rhesus* clambered at once upon the vertical wires of his cage, climbed on them as he would, up and down, took a few steps upon the straw, sprang freely from the top of his cage down onto his four hands and then against the grating onto which he climbed with an agility and security, which would have done honor to the most skillful monkey. The mother followed each movement of her young with the closest attention and appeared always ready

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[1] Cassell's Natural History, p. 121.

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AN ANALYTIC STUDY OF THE MEMORY IMAGE AND THE PROCESS OF JUDGMENT IN THE DISCRIMINATION OF CLANGS AND TONES. (Concluded.)[1]

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EXPERIMENTAL. CHAPTER II. (*Continued.*)

PART III.

The problems previously considered, viz., the nature and course of the tonal memory image and the nature of the judgment consciousness, are in Part 3 examined by the aid of what may be termed the method of continuous change or the method of reaction. The second tone, V, starts from above or below the standard, N, and moves uniformly toward N until arrested by the observer when subjective equality is reached. The method thus differs from that employed in Parts 1 and 2 for (1) a moving tone is used for V in place of the discrete stimulus of the method right and wrong cases, while (2) the judgment is always that of 'equal' and (3) a movement of reaction is required on the part of the observer.

The method is most similar to that of equivalents[2] with the introduction of a time-interval between N and V. It yields two values, $V_o ||| N$ and $V_u ||| N$, these being the averages of the determinations of subjective equality made in a certain number (in Table VII, six) of movements of V from above and from below N respectively. The mean of these two values, taken algebraically, indicates, by its size and sign, the amount and nature of any tendency on the part of the observer to err in a greater degree upon one side or the other of N. This value corresponds to the 'true subjective equality' of the method of equivalents proper, but we have chosen to term it the 'estimation value of N.' Finally, the mean of these two values, arithmetically taken, indicates the average distance from N of the upper and lower boundaries of the 'zone of equality.' In a few cases, as the tables show, the signs of the two values of V ||| N are alike; then obviously, the 'average limit of error' coincides with the 'estimation value of N,' and simply determines the center of the 'zone of equality.'

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[1] For the first article, see this *Journal*, XII, 1901, 409-457.

[2] Külpe: *Outlines of Psychology*, 1895, 56 f. It may be likened also in some respects to the reaction method as described by Stern (*Psych. d. Veränderungsauffassung*, 108 ff.), who says, "das Characteristische des Reactionsverfahrens besteht darin, dass die Veränderung solange währt, bis die Versuchsperson selbst ihr durch eine Reactionsbewegung ein Ziel setzt." It is hardly necessary to point out that Stern's application of the method was made with a different purpose (the perception of change itself), so that the variable moved more slowly, and not, as in our tests, from a given D toward equality. These points of difference preclude extended comparison of results.

In his use of the reaction method Stern[1] saw fit to subtract a constant value, 0.5 sec., assumed to represent the reaction-time. We have not carried out any subtraction in the present Tables for several reasons.

1. Though the value of the reaction-time is, according to Stern, higher for continuously changing than for discrete stimuli, it decreases as the rate of the variation increases.[2] Since our rate is much faster than any of those employed by Stern, the value in question would be much nearer the simple reaction-time to discrete stimuli than 0.5 second.

2. Stern also includes in the subtracted interval a period known as the 'decision-time.' This is due to an inhibition of reaction, set up by the attempt to secure greater certainty. "Man lässt das Urteil erst eine gewisse Sicherheit gewinnen, ehe man sich zur Bewegung entschliesst; die Anregung zur motorischen Aktion ist bei allmählichen Veränderungen eine sehr geringe." Under the conditions of our own tests, we very much doubt whether this influence is to be reckoned with at all. To be sure we find everywhere evidences of a tendency to premature reaction which is being met by obvious conscious attempts to inhibit it, and this process might seem, on first thought, to be identical with the above-mentioned retardation of the decision. But these are two distinct phenomena. Stern says that the decision-time is "eine, wenn auch *kurze*, so doch nicht ganz zu vernachlässigende Zeit." Under our conditions several tendencies to react may appear and be inhibited before the actual movement, while the interval between each one may be of perhaps one second's duration. It would be manifestly absurd to add these relatively long periods to the observer's reaction-time proper for the purpose of subtraction.

If, however, there should be present a retardation of the reaction of very short duration such as Stern mentions, it seems quite appropriate that this time should be rather included than excluded from the results, for the delay is made for the sake of subjective certainty, and the recorded values will therefore in-are so adjusted that when the observer closes a circuit key, the teeth instantly engage the cogs of the gear wheels so firmly as immediately to stop the movement of the crank by the operator. The advantage of this device over the stop-watch[1] is obvious.

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[1] *Zeits. f. Psych*, vii, 1894, 270:
109 f.

[2] *Veränderungsauffassung*

Method of Procedure. One of three standard tones, *a*, *b*, or *c* (corresponding to settings 5, 15, and 25 of the apparatus, and to the pitches 242, 270, and 298 vibs. respectively)is given with a duration of one second, beginning two seconds after the usual 'now.' After an interval (10 or 40 seconds), a second tone, V, is given, which begins 3, 4, or 5 turns of the crank in either direction from the standard setting (*i. e.*, at 8.4, 12.2 or 14.0 vibs. above or below N), and moves uniformly toward the standard, always at the rate of one-half revolution of the crank (1.4 vibs.) per second. When the observer[2] thinks that V is equal to N, he presses the key which, as was above explained, stops the movement of N. The observer dictates his introspection and the operator records the setting of the apparatus in terms of revolutions and hundredths of a revolution, thus giving readings within 0.028 vib. The observer's error is later computed in terms of vibration rate. The observers are *M*, *B*, *S* and *Wh*.[3]

The experiments of Part III are subdivided into four Series, whose conditions are varied in three respects, (1) by using a time interval of 10 or of 40 seconds (2) by procedure with or without *specific* knowledge, and (3) by active attention to, or active inhibition of, the image (artificial distraction).

Series 1.

Series 1 consists of three sets of 18 tests each for each observer at 10 seconds interval. The first set is not figured in the quantitative results because of the rapid growth of special practice which took place at the outset. The third set is taken late in the course of Part III (directly after a series in which the procedure is with knowledge), but is treated in connection with the second, so that Series I, as represented, practically consists of 36 tests for each observer.

In order to make these tests more comparable with those by right and wrong cases, and to avoid the error of expectation so far as possible, the procedure is without knowledge. But this phrase must be used with qualifications. By it is meant that there is no knowledge of the *standard* to be used, of the *amount* of the difference, D, of the *absolute rate* or of the *direction*, of the umn of the average limit of error.

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[1] Employed by Stern for a similar purpose: *Zeits. f. Psych.*, xi, 1896, 20; xxii, 1899, 2.

[2] In this procedure, naturally, but one observer is tested at a sitting.

[3] Dr. W. C. Bagley kindly served as operator for *Wh* in Part 3.

3. The mean variations are large.

4. *M* and *Wh* constantly underestimate, *B* and *S* constantly overestimate N. This feature is of itself indicative of some individual differences in the manner of judging, so that we are led to examine the judgment consciousness as it is revealed by the introspection.

QUALITATIVE RESULTS.

A. Features common to all observers.

The introspection throws light upon several minor features; *e. g.*, the manner in which the position of V is first known, the nature of its movement, the existence of a curious 'after-tone,' etc., besides yielding, what is more to our point, a satisfactory analysis of the judgment-consciousness. The chief matters of interest in this analysis are the direction of the attention, the ultimate basis of the judgment, the influence of expectation, the feeling of assurance, and the nature of the reaction movement. These factors must, for the most part, be discussed in the light of the reports of each observer separately. But in five respects, viz., the knowledge of the position of V, the nature of the movement of V, the nature and influence of expectation, the 'after-tone,' and the assurance, the reports of the observers exhibit such community that these topics may be profitably discussed at the outset.

Knowledge of the position of V. Observers *M*, *B* and *Wh* as a rule knew N as soon as it sounded; *S*, as might be expected from her poor sensible discrimination, had more difficulty and frequently relied upon her observation of the direction of the movement to gain her knowledge of the position of the starting point. However, the wider D's offered little difficulty. It is of interest to note that large D's produce in an exaggerated manner the organic shifts which have already been reported as characteristic of the 'higher' and 'lower' feels of compared tones. For example, the slight feeling of relaxation which was noted by several observers in the tests with discrete tones (D = 8 vibs.) became exaggerated into a very distinct slump or depression when V differed from N by 14 vibs. "V caused a sudden feeling of drop, very like the feeling you get when you wake up suddenly thinking you are falling" (*B*). "The recognition of the place of V above or below the image is nearly always immediate, and similar to that in

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equality will be passed. Both the observers in question, *S* and *Wh*, note this explicitly; *e. g.*, "Feeling the error of anticipation, I now have a tendency to restrain the reaction. With a small D, therefore, the time to equality is so short that I overdo this and react too slowly."

ing which V is sounding. It is small wonder, then, that despite the precautionary check to hasty reaction which the wide D itself affords, the observer should yield to the temptation to "have it over with." This occurrence is frequently reported thus: "With a wide D, I get tired of waiting." "D was wide and the strain on the attention so great that I reacted even with the thought that it was not yet quite equal; but still I felt that I must get through with it." "When D is wide, I now make a distinct effort not to hurry, but still I react too soon" (*B*). Again the expectation may be set and released at a definite point, this point being determined by an estimate of the amount of the D.[1] In these cases, obviously, the judgment is determined by the lapse of that amount of time, which, it is inferred, should bring V to the point of equality. Here, however, we may regard this process as one phase of the expectation tendency. This influence may determine the judgment quite by itself, or it may modify the natural course of the reaction which would otherwise ensue, *i. e.*, frequently an observer says he felt that V must have reached N, although equality had not yet been attained on the basis of auditory recognition. Illustrations are: "Felt it must be time to react though V was not quite back to what I wished" (*Wh*). "Was n't quite there, but felt it ought to be, probably from my previous estimation of D" (*B*).

Finally, there is a simple sort of expectation which is a very potent factor in the judgment consciousness, but which cannot be more accurately defined than a dread of getting past equality. Apparently the feeling is that, once equality be past, one would be helpless, for the moving tone would then be constantly getting *away* from the desired point. Perhaps this interpretation is too much logical, and too little psychological, but, whether or no this much is in the observer's mind, the action of some such motive is very evident from the following examples: "Scared stiff for fear of passing equality." "There is still almost as much excitement now as at first. I can't look at the matter calmly" (*M*). "I get worried when V approaches N for fear it will get away from me" (*S*). The experimenter can attest that this expectant attitude is clearly visible by all the usual outward tokens of the keenest sort of attention, which culminates, at least, during the earlier tests, in distinct agitation at the crucial point. Now it would seem very probable that so vivid an expectation would be noted by the observers, and that deliberate attempts would be made to counteract its influence. We have already quoted extracts which show that such is actually the case. What is most remarkable is that, save in exceptional individual tests, this deliberate inhibition of the tendency to premature reaction is never adequate. When the observer is making a conscious effort to retard his judgment, and when this effort seems to him to have been adequate, or more than adequate (so that he complains that he has passed equality, has waited too long), even then the subconscious tendencies prevail, and an expectation error appears. "With wide D's, I now make a distinct effort to wait" (*B*). "I think I now generally wait a little after V seems at equality to make fully sure of it." "There is an area of equality. If I am excited, I react as soon as I get to it; if cool or confident, I wait till I am well within this area" (*Wh*). Often the natural influence of the wide D to heighten expectation is combated with varying success by the time inference; *i. e.*, that since D is wide, it will take more time to reach equality. The resultant reactions are thus subject to noticeable variations. This is one of the influences which produce such large mean variations. A single case will illustrate. "A very big D going down. . . . . I passed through a period of seeming equality, felt it time to react, but hesitated (probably because D was wide and the time then elapsed but short); then, after a tonal *difference*, entered *another* period of equality and reacted" (*Wh*). [Result, still 0.6 vibs. too high.]

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[1] This point will be further discussed below when the basis of judgment is mentioned.

The after-tone. It will be remembered that the moving tone was arrested by the direct action of the armature of an electromagnet upon the gear wheels: the actual movement was very short, and its inertia was reduced to the lowest point by proper adjustment of the springs controlling the armature; nevertheless, all four observers quite independently noted that after the key had been pressed there was a distinct additional movement of the tone. By listening to this 'after-tone,' observers *B* and *S* quite frequently, *M* less often, decided whether the reaction had been made too soon or too late, and in this manner they evolved a sort of control over their natural expectation error.[1] Typical reports are: "After judgment is made and the key pressed, V has moved some since my decision (*S*). "After reaction, noted after-tone and thought 'I should have waited longer; that tone was nearer the right one'" (*M*). "At the moment I press the key, the tones seem equal; then immediately afterwards I listen to V and see that I did not wait long enough" (*B*). "At judgment, thought 'too low,' but after-tone seemed about right" (*B*). To obviate this peculiar influence, it became necessary finally to put in the reaction circuit a rather loud 'buzzer;' which sounded whenever the key was pressed, *i. e.*, simultaneously with the action of the armature clutch. The intensity was sufficient to drown the bottle-tone. The introduction of this noise, however, did not, curiously enough, accomplish the purpose for which it was intended, for despite the sound of the 'buzzer,' *B* and *S* occasionally reported the after-tone. More careful observation then brought out the real nature of the phenomenon. The so-called 'after-tone' is in reality due to a subjective process,—the formulation and execution of the judgment withdraws the attention for a very short time from the stimulus. The observer then hears that portion of the moving tone which sounds after his impulse to react and before the action of the clutch and the noise buzzer stop both the movement and, so far as the observer is concerned, the sound of the variable tone. This explanation will be clearer when the nature of the apparent movement of the variable tone and the influence of expectation are recalled. The movement of V takes place not uniformly, but by a series of slumps or slurs. One of these sudden changes may take place just after an impulse to react matures. The general effect of expectation is, we think, to cause the incoming variable stimulus to seem nearer the standard than it actually is. When the test is completed by the decision, the influence of expectation is suddenly thrown off and the observer hears the tone quite distinctly different in pitch from the tone noted a moment before when the key was pressed.

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[1] *Wh* noted the tone, but did not use it as a corrective of his judgments.

Assurance. From the very nature of the continuous change tests, one cannot expect the observers to exhibit that degree of certainty which is obtainable in the tests with discrete stimuli. There the answer was definitely right or wrong. Here only a very happy chance can bring the reaction movement at precisely the fraction of a second when V is passing the point of equality. The influence of expectation and of the attempts to counteract it also plays some part in lessening the observer's assurance.

We prefer to speak rather of the observer's assurance than of his certainty, and to retain the latter term for the method of judgment, for, in the present case, no observer can say definitely that his reaction was made at precisely the proper moment; he can only feel an assurance that it is "pretty good," "somewhere near," or "the best I could do." As *Wh* expressed it, there is not a point, but an area, of subjective equality, and that reaction is felt to be satisfactory which is within this area. Even so, the assurance of the observers is never very great. It is often affected either favorably or unfavorably by the after-tone. The following are typical reports: "V not like my image, but the nearest thing that had come."

"Judgment rather uncertain. Thought it too slow at first, then, hearing the after-tone, decided not." "After reaction thought I had only reached the *edge*" (*M*). "I never get any definite recognition, but I stop the tone when it is near it. Don't usually know the direction of error" (*S*). "Not just right, but don't know which way the error is" (*B*). "Decision fair, but not a 'dead-sure' feeling" (*Wh*).

B. Features peculiar to individual observers.

We have just discussed certain features of the qualitative results of the continuous change method which were common to the reports of all the observers. This discussion revealed the existence of a peculiar after-tone, largely subjective in nature, which was used to control decisions, and of a strong expectation tendency which was fostered by several contributory motives, but counteracted by conscious attempts at restraint. Furthermore, it was shown that the perception of the starting-point of V, and that of its movement, involved practically similar experiences for all observers. The degree of assurance was quite similar for all. One might, therefore, suppose that there would be little room for individual variation in the reaction-consciousness. But such a supposition is too hasty; it neglects the fact that the passing of a single decision is the result of the operation of a very complex tangle of mental processes, of the function of a fairly large number of factors, each of which has its own special influence upon the outcome. Indeed, it seems, in many instances, impossible for the best trained observer to unravel the tangle, and to designate the amount of the influence which is to be ascribed to each of the factors in operation. We must be content if the observer can indicate the striking mental structures in every particular test, and if he can, in the course of a large number of introspective reports, indicate, from time to time, the less obvious structures which are to be found in his typical experiences. In this way, we can hope to obtain, in the first place, a tolerably accurate knowledge of the general process of judgment for each observer, and, in the second place, an account of the one or more particular features which have been prominent in each single decision.[1]

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[1] One of the most interesting things which appeared in our reports was the tendency of the observers to specialize upon some particular introspective feature during each sitting. Thus, to take a single example, *S* gives her attention on one day quite exclusively to visualization, on another to temperature associations, on a third to the nature of the familiarity feel. This tendency reminds us of the readiness with which the observers pick up suggestions as to the probable content of the judgment consciousness (first article, 424). This emphasis upon certain phases during certain groups of tests must be fully

Perhaps we may simplify the consideration of the reaction-consciousness, if, while recognizing the truly unlooked for complexity of its structure, we attempt to outline some of the main directions in which individual variations may be expected.

I. As we have already pointed out, the attempt to restrain the expectation error may be successful or unsuccessful, nor can we predict, even in the case of a single observer, kept under constant objective conditions, that the outcome will be uniformly in favor of either tendency.

II. Some observers have a distinct emotional preference in regard to the direction of V, *i. e.*, they prefer to listen to a rising, or to a falling, variable stimulus.

III. The attention may be directed (*a*) uniformly upon the image of N, (*b*) uniformly towards V, either (1) directly upon V itself, or (2) indirectly upon V by the use of an anticipatory, changing image,[1] (*c*) alternately upon the image and upon V, either (1) by a series of rapid alterations, or (2) by a single shift to V near equality.

IV. The basis of the decision may be (*a*) tonal, in terms of (1) equality, (2) familiarity, (3) some change in V, (*b*) visual or visual-motor, (*c*) an inference in terms of the elapsed time.

V. The reaction movement may be (*a*) entirely automatic, or (*b*) an occasional source of distraction.

VI. There may be possible contrasts with preceding tests.

If, to these possible variations, we add the existing variations in the individual capacity to attend to the stimulus and to retain the memory image which our preceding tests have brought to light, as well as the variations in the sensible discrimination of our observers, we shall be prepared to find large mean variations in the numerical results and noticeable points of difference in the introspective verdicts.

Observer M.

M prefers to have V 'settle.' Once there was a curious illogical experience. V rose and went past equality without at any time passing through equality. The reaction was too soon; apparently expectation was excessively strong.

The usual *method of decision* is to hold the image as long as possible, then to turn the attention to V (which is, by this

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realized in the interpretation of the introspection, and not too carelessly ascribed to the objective conditions of the series in use at the time. Moreover, we think it likely that this sort of 'auto-suggestion,' if that term may be used, may lead the observer to occasional bits of faulty introspection. Thus, during one of her 'temperature days,' *S* gave the following rather doubtful case: "Image not very good. The electric lights went on just before the test: seems as if they made me feel warmer, and therefore sharped my image."

[1] See under observer *Wh*, pp. 237-8.

time, near equality). The reaction occurs when V, by becoming (subjectively) more intense and "bigger," signalizes the matching-point, or when, as a result of rapid comparisons, there is an auditory or a visual 'match.' As in the tests of Parts I and II, *M*'s experience is suffused with lively visual and visual-motor imagery which is often of assistance in the decision.

The *movement of reaction* is apt to demand conscious attention.

These points are illustrated by the following introspective evidence: "Followed V down with my eyes in my imagination. Compared V with N twice at intervals, then two very quick ones when it got near." "Held image till V got near, then made two comparisons." "The series of auditory comparisons is pronounced in the form of a series of verbal judgments,—'too high,' 'too high,' 'high,' 'there.'" "V seems to swell out and get more intense at the point of equality, and this helps the judgment This is very comforting; reminds me of the apparent spread of the æsthesiometric compass when it comes to a more sensitive area." "N on a plane by my eyes. V moved up vertically till it coincided." "N was like a caterpillar, fuzzy, yet too small in the middle, a thin thing, and very hard to remember. When V got fuzzy and thin and removed the image, I reacted." "Lost the image finally, so attended to V which recalled N at the time of the reaction." "Hate the bell; it laughs at you when you are wrong." "Frequently have to think of the button at the reaction, and this is felt to be a confusion and a bother."

Observer B.

B prefers to have V move down; it is easier to react then than when V moves up. In the latter case, there is more strain and nervousness, greater expectation, and a change from the usual method of judgment, much attention being given to the image.

The usual *method of decision* is to give full attention to V, the image being present, if at all, only feebly in the background. "I attend only to V, not comparing it at all with N. The image is hardly ever present in the reaction consciousness, and not usually present at all after V sounds." There may be, as we saw in Part I, an attempt to use the image in unusually difficult cases. "I react by attending to V and watching for a feeling or coloring of the tone which means equality. If this seems too difficult, I pull up the image for comparison, but it is very confusing to try to hold the image and attend to V at the same time."

The amount of D at which V starts exercises a strong influence upon the reaction consciousness of *B*. Very frequentl the actual movement of reaction is entirely determined by thi means, in other cases its approximate time only. Thus if D i large, expectation may be increased or a sudden caution b born. "Was n't quite there, but felt it ought to be, perhaps from a previous estimate of D, so I reacted." "At wide D's, I often now make a distinct effort to wait." "As soon as V sounds, I determine about how long it will take to get back." "Not much D, so I thought 'it won't take long to get there.'" "A wide D demands too much strain of the attention; sometimes, however, it makes me cautious and I go slower."

This observer, though very musical and generally recognizing the position of V at once, had several peculiar experiences with the *movement of V*. "Went up too fast at last; a sudden jump made V really too high at the decision." "V started at or near equality. At any rate, it never was equal to N at any time save possibly at the start." "V started right on N, I am positive." With one test (D = —11.2 vibs.) nine trials were necessary before *B* interpreted the conditions correctly; eight times it was reported that V began at N, or below N, and went lower yet. Finally *B* announced in despair "I 'm all mixed up; I believe you are playing tricks with me."

Expectation and the time factor. The persistence with which the expectation error appeared in the case of *B*, and the rather striking fact that this error increased as D increased by nearly the same amount, led to the suspicion that *B* was reacting almost entirely in terms of time; that, for some reason not clearly obvious, the movement of reaction took place at practically the same time after the sounding of V, notwithstanding the three very different values of D in use.[1]

A series of 'puzzle-tests' (*Vexirversuche*) was accordingly planned to discover whether *B* was influenced by some 'habitual-time' tendency, analogous to an 'optimal-time' influence. In these tests variations were tried in the amount of D (using 0, 5.9, 9.8, 15.4 and 19.6 vibs. in place of the usual values), and in the direction of V, which was kept at zero, or moved away from N, etc., etc. The regular time-interval, 10 seconds, was employed. Not until *eight* such tests had been given did *B* suspect anything unusual. She then exclaimed: "that tone went the wrong way, though I first thought it was moving up. I 'm afraid you are trying to trick me." This is a very forcible illustration of the confidence which the routine of a long continued experiment will inspire.

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[1] The alternative explanation is that the expectation error increases uniformly with increase of D.

So habituated was *B* to the method of procedure that eight puzzle-tests were required to shake this confidence. In several of the tests the unusual conditions produced curious illusions; thus V was given = N: *B* reacted after 3.6 seconds, giving as her report,—" V higher, ran down. Reaction possibly too soon, but very good. I can always tell that (!)."[1] These tests were continued until 25 were given. After the eighth, *B* became more cautious; at the 17th she concluded that new *rates* of change were being used. There still remained a surprising amount of confusion as to the position, but more especially as to the direction of V. Thus, V was once started 11.2 vibs. below N and then *lowered* at the usual rate, after nearly 15 seconds, *B* reacted when V was 31.8 vibs. below N or 20.6 vibs. below the starting-point of V. According to the report, " V at first went up; then it seemed to get more piercing, and for a long time I could n't tell which way it went. Finally it got milder and nearly like N, but the judgment was probably a little low."

If we compute the length of time from the sounding of V to the movement of reaction, we find, for the three values of D used in the regular tests, *i. e.*, for 8.4, 11.2 and 14.0 vibs. respectively, the following periods in seconds,—[2] 2.46, 3.58 and 3.18. If now we compute the corresponding values for the new D's used in the puzzle-tests, we find for 5.6 and 9.8 vibs. the values 3.84 and 3.70 seconds respectively.[3] The average for these 5 D's is 3.35 ± .43 seconds. This result is confirmatory of our hypothesis of an 'habitual-time.' It may be worth while to recall here the test mentioned above in which *B* reacted to a V = N after 3.6 seconds. We conclude, from these indications, that *B* is influenced by a very strong tendency to react at about three and a half seconds after the sounding of V.[4] This tendency makes itself felt almost entirely in tests in which D is plus.[1] Very likely this is correlated with the preference above mentioned for a descending variable because of the ease of judgment then. The 'ease,' we think, is due to the control exercised by this unconscious 'time-release' factor.

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[1] *Cf.* Stern, *Veränderungsauffassung*, 94; Seashore, *Studies from the Yale Psych. Lab.*, III, 1895, 29 ff.

[2] These values do not correspond with those given in Table VII because they are the average for those tests only which were made before the puzzle-tests had made *B* more cautious.

[3] The remaining puzzle D's, 15.4 and 19.6 vibs., were so unusually large that it is too much to expect that the elapsed-time influence should make itself felt without restriction. Their values, 5.02 and 5.90 seconds, are accordingly omitted.

[4] Despite the differences in the conditions, it seems quite probable that this influence is akin, if not identical with, Stern's 'optimal-time.' At any rate his times (3.3, 3.9, 3.7 seconds) are curiously like those obtained by us, and the statement of the law (p. 236) might equally well apply to observer *B:* " Wenn jemand einen Veränderungsreiz stetig beobachtet und den Wahrnehmungsaugenblick selbst feststellen soll, so tritt um etwa vier Secunden herum eine kritische Zeit erster Ordnung ein. Die Aufmerksamkeit ist auf's höchste gesteigert, die Erwartung drängt zur Entladung, und das abschliessende Urteil wird, wenn irgend möglich, gefällt: hierbei ist dann die ob-

Observer S.

One of the most prominent features in *S*'s introspection is the *identification of N* by the use of several different categories. This seems to be partly a relic of the procedure with right and wrong cases[2] (each N being, as soon as heard, compared with the N of the preceding test), and partly a desire to gain a feeling of order and security in the work by arranging a schema of the standards in use. *S* thought at first that there were six or seven, later three or four standards. These appeal to her as differing from each other not only auditorily, but in temperature[3] and size, and occasionally in other respects, personal characteristics, etc. "N places itself in my scale auditorily, visually and in regard to its temperature, and remains placed there throughout the test. The warmest N is comfortably warm, more than lukewarm; the coldest is just like pleasantly cool water, this being the lowest tone used. Some tones are masculine, others (generally the higher ones) feminine." "Could not place this N in my series, and this bothered me as it gives me confidence to get N put readily into my scheme of identification."

Though, as might be expected, this process of identification was not always successful, the assignment was more often than not correct. There is no question but that the contribution supplied by the other sense departments is the essential basis of this process. *S* knows that a given N is a cool one before she knows that it is (relatively) low in pitch. Here we have a striking illustration of an unusual and unlooked-for means for the recognition of the impressions of one sense department in terms of another. It seems quite unreasonable, logically, but not, after all, so unreasonable psychologically, for, as we have already pointed out, *S* has a poor auditory discrimination, but a very strong affective reaction to tones. It is this affective supplement which catches the attention, therefore, and which gives individuality to the various standards.

The same prominence of *visual factors* which characterized *S*'s experiences previously appeared here again with even

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jective Grösse, welche die Veränderung in jener Zeit erlangt hat, innerhalb weiter Grenzen irrelevant."

[1] The figures just given all refer to a descending variable tone.

[2] *Cf.* especially 439 (6) of the first article.

[3] *Cf.* first article, 420, 428, 437, 451.

ter distinctness than before. We have said that N seemed ve a certain visual size and place. V invariably evokes a more pronounced visualization, usually described as "a y, gray round thing moving up or down and making a as it goes. "I watch the moving end or knob. N is a ar round stationary thing at the left of V. I seem to stay e V side and look towards the image on the left. When es down it drops vertically, but when it goes up, it al- s moves obliquely out away from me at an angle of about egrees." The visual phenomena thus described are not so e as determining agents in the reaction consciousness as e which serve to identify N. Here they are, as *S* puts it, er the expression of the auditory relations between V and N. he actual *decision* is usually either (1) the result of a series uditory comparisons (the attention being for the most part N, and jumping over to the image for a moment), or (2) result of some modification of V. It is noticeable that the er type of decision became more prominent as the work gressed, less and less importance being attached to the im- This is entirely in accordance with what we have already occasion to mention so frequently,—that the process of ge-comparison is used in cases of difficulty when the direct hod is, for any reason, not available. The modification of ay be an auditory swelling, as in the case of the observer but oftener it takes the form of some organic or affective re- nse. "Reaction based this time upon a certain individual- which appeared in one place in V,—something auditory haps." "When I reacted, V 'stood out,' was 'my tone.'" t times, at the moment of reaction I see a whitish convex g which appeals to me as something graspable; the rest of tone is not thus graspable." (3) A third, somewhat less uent, basis for the decision is the experience of a sudden *ily glow or warmth.* We may suppose that this is a con- uent of the organic reaction which forms the essence of the ood of familiarity' or 'quality of knowness' for this ob- ver, but like many constituents which enter into rapid and plex mental processes, its presence is only distinctly made in occasional introspections when the conditions favor lysis. It is credible, too, that *S*, who experiences strong ctively colored associations of temperature with tones, uld, on that very account, be the observer to analyze out s particular feature of the familiarity feel most successfully. the other hand, *S* herself says that the warmth which es with recognition is quite distinct from that which is ribed to tones. The former is experienced in other cases n in the recognition of tones; it comes, for example, when point of an argument in a lecture becomes suddenly clear.

The similarity of this case to the recognitory consciousness in our tests is not very difficult to perceive.

There remains to be mentioned, in the case of *S*, a strong preference for a rising V. "It is pleasant to have V grow strong and big, depressing to feel it sink." One may accordingly explain the overestimation error as due to an unconscious prolongation of the pleasurable movement of rising variables, or to an unconscious premature checking of the depressing movement of descending variables.

It has already been mentioned that *S*, owing to a poor sensible discrimination, had, at times, difficulty in perceiving the *position of V* at once, especially with the smallest D. Frequently the actual movement of the tone supplied the desired knowledge. In nine out of 36 tests, however, *S* carried out the tests completely and then reported that V moved in the opposite direction to that actually executed. These tests were given again (being interspersed in a regular series) until correctly interpreted. A single repetition was sufficient in six cases, three or four in the others. In five cases, D was 8.4 vibs., in two cases, 11.2, in two cases, 14.0. These rather anomalous results raise an interesting point. How are we to interpret the quantitative value of *S*'s tests, especially her estimate of equality, when, to take one example, V was descending from 14.0 vibs., and *S* reported: "V went up, a good swelling tone; judgment of recognition?" A more hopeless confusion of the objective conditions could scarcely be imagined in view of the long practice *S* had had. We are still, however, ready to assert that the reaction might quite well have indicated a real recognition of the merging of a difference into an equality. The results of *B*'s puzzle-tests show how easily the direction of a movement of a continuously changing tone may be mistaken. It has, again, often been asserted, and our previous results have everywhere confirmed the assertion, that difference is more readily noted than the direction of the difference. Finally, we have shown how dependent *S* often is upon supplementary contributions from other modalities for her perception of tonal relations. The introspective evidence points clearly to the influence of these contributions in producing many of the confusions. If a tone seems to be 'swelling,' or is visualized in the wrong position, this is enough to override the direct perception of its auditory relations. *S* herself says: "I think I am too much influenced at times by my visualizations." We may conclude, then, that in the case of *S*, some one of a number of extraneous factors causes a misapprehension of the proper place of V; this influence is so strong that, coupled with the general difficulty of perceiving the direction, it overrides the objective conditions. However, *S* knows that V is different from N, and makes a satisfactory reaction when it reaches equality.

S noted occasionally a short but distinct interval between the formation of the decision and the pressing of the reaction key.

Observer Wh.

The method of decision in the case of *Wh*, although it changed as the tests progressed, was throughout much more exclusively auditory than that of the other observers. At first there was a series of auditory comparisons. But very soon comparison was given up, although the auditory image was still maintained by effort during the time-interval, and, as long as possible during the sounding of V.[1]

The common method pursued by *Wh* is thus that in which the judgment is auditory-motor (or auditory), the attention being held upon the image with all possible persistence, not alternating between the image and N, but merely waiting for coincidence. When, however, D is large, there are what *Wh* calls occcasional 'looks' at V (not comparisons or 'balancings,' but brief shifts of the attention).[2] "I image the ideal tone as soon as V sounds and keep this ideal in mind somehow, but toward the end my attention 'flops over' to V, and I come down with it to the place (*i. e.*, N) from which I had jumped to it. The 'flopping over' has a distinct motor feel about it." "Once I tried so hard to think the image that I did n't attend to V at all, so that the decision was very uncertain. Found no equality point at all." "I still hold to the image, but it seems a place in space to get to quite as much as an auditory quality, for the tonal image is not distinctly present."

The second chief method used by *Wh* is a peculiar one, for the attention is not directly upon either the image or V; in fact, there cannot be said to be any image in use, in so far as we mean by the image a representation of N. As V moves along by a series of slumps or slurs (descending or ascending V respectively), *Wh* at each stage imagines what the next stage is to be. Perhaps an introspective report will make this clearer. "I attend in a way to V, yet I am, so to speak, going ahead of it auditorily and coaxing it along; mentally hearing it take its course from difference to equality just in advance of the tone itself. When V has completed the path I thus made for it, I react."

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[1] Naturally, as we have seen in the case of the other observers, when V gets so near N that it becomes a source of confusion to the image, the attention, compelled by the insistence of the sounding tone in contrast to the natural feebleness of the image, is very apt to go over to the variable and be held there until the reaction. As the tests continued, the spatial characteristics of the image became of more importance, and the image (we use the term for whatever is held in consciousness to represent N) lost much of its auditory nature.

[2] In distinction, for example, from the procedure of *M* in passing a series of verbal judgments.

Finally, *Wh* uses occasionally the method already mentioned of relying solely upon some change in the (subjective) nature of V or upon the appearance of some familiarity feel. This form of decision is not used by this observer save when other means fail. "Distinct swelling of V at the right place." "No image at V, so attended to V to see when it got familiar. At a certain area it aroused a 'familiarity tag' and the reaction. I 'm not at all sure of this sort, rather have some idea of the place of N in mind all the time." "When D is very large, I sometimes lose my image-place entirely and have to go by the familiarity feel."

The *amount of D* did not exercise over *Wh* so great an influence as upon the other observers (especially *B*). Occasionally, of course, a wide D increased the tendency to premature reaction: "Big D; had a strong expectation which made the rate of V surprisingly slow." More frequently quite the reverse effect appears: "Pleased with wide D, for then there is plenty of time. I can be calm and make the reaction coolly."

The influence of D as a determinant of the reaction by a computation of the time necessary (*i. e.*, quite apart from its influence upon expectation) seems not very strong with *Wh*. While cases appear like those of observer *B*, there are many others in which the estimate of the size of D, instead of determining the moment of the reaction, is itself revised by the influence of the other factors in the judgment consciousness. "I thought the D was small, but the tone was some time in reaching equality, so (as I know this means a wide D) concluded I was mistaken in my first thought."

The *movement of reaction* "seems now to be fixed, united with N, in such a way that whenever V reaches N, the reaction 'goes off,' usually quite automatically." "Just before V gets to equality, I put my finger on the key, my arm muscles set for the movement, and feel in general a very pleasant anticipation of making the reaction. It is a sort of 'hitting the nail on the head' feeling, or like chopping a running rope at some fixed point."

Series 2.

This series consists of 36 tests for each observer, identical with those of Series 1, save that the time-interval is 40 seconds.

The *quantitative results* are extremely irregular, so much so that it is useless to present them in tabular form for extended comparison with those of the other series. It will suffice to point out, for example, that in five out of 24 cases the expectation error disappears, that there is, in the remaining cases, no sign of any relation between this error and the size of D, that the mean variations (except for *S*) are uniformly larger than before, that the estimation value of N is not constant in sign for any observer (save for *B* who underestimates with all three values of D).

The cause of this rather unsatisfactory outcome from the quantitative point of view is not far to seek. It is due to the fact that, to the natural difficulties of the continuous change method which we have just discussed in detail, there is added the difficulty of the long time-interval.

The *qualitative reports* are quite as irregular and quite as difficult to put into tabular form as the quantitative. To begin with, the observers differ very much in their use of the auditory image. Thus, in 36 tests, *M* reported 25 cases in which the image was present in the decision (in 22 of them after having persisted throughout the interval), three in which it was not present, and eight unclassified; *B*, on the contrary, reported only 10 cases with the image and 13 without it, while the remaining 13, in which this point was not explicitly settled, probably belong to the latter type. *S* makes use of her visual images quite frequently; *Wh* reacted with an auditory image 16 times, without any 13 times.

Despite these variations, the following general propositions may be laid down. (1) Owing to the long practice now attained, the auditory image can be held somewhat better than during Series 3 of Part 2. (2) The presence of the image (even if the auditory core is lacking) affords greater assurance in the reaction. (3) It is helpful to have the image persist in some form until V starts, even if it does not enter consciousness again; to have in mind a definite place for N when V begins, because recourse is thus had to a decision based on the amount of D. (4) It is, however, possible to make an objectively satisfactory reaction when the image has been permanently lost before V sounds. Such reactions are most frequent for observers *B* and *Wh*. *B* finds them subjectively satisfactory, *Wh* much less so. The actual basis of the decision of this type varies. If the recognition seems rather hopeless, the observer is apt to catch at the slightest indication of equality. "Image entirely gone, yet knew V started below. This time, however, I had neither a tone nor a place in mind for V to reach. So I watched V to get a familiarity, but reaction was really largely due to a feeling that V had gone on long enough" (*Wh*). "The familiarity feel seems to be something bodily which comes on gradually and finally engulfs me" (*Wh*). "Sometimes the visualized starts or not, the fact that its pitch (and also, as a rule, the various organic sets and other associative supplementings) has been gradually raised in the endeavor to maintain it as vividly and clearly as possible, brings it about that the 'level' representing the place of the standard has been altered at V. Putting the matter in another way, the unconscious, gradual sharping of the image during, say, 30 seconds, will affect the identification of V at the 40th second, even if the auditory image has ceased to be consciously present. "Image absolutely gone, but V immediately aroused a verbal 'high,' and was felt to be *so* high. I knew at once approximately *where* the image must have been, though I did n't hear the image sound again" (*Wh*).

In connection with the gradual fading of the image and the difficulty of maintaining it in serviceable condition for the 40 seconds interval, there should be noted a very frequently reported phenomenon, that of the *arbitrary alteration or displacement of the auditory image.*[1] Apparently the auditory image is not always the determinative feature of the complex which stands for N during the interval. The observer sometimes controls the tonal image by reference to some other material as a basis. This scrutiny of the image is clearly illustrated in the ensuing quotations. "Two images during the interval. Knew the higher was the correct one." "Put this image too far down, misjudged it, so when it insisted on raising itself, I had to let it do so." "Lost image for awhile; then two came back, distinct from each other, auditorily and spatially. The real one was the upper one, but it had a tendency to fall down into the lower one, so that I had to keep pushing it up. It was a regular nightmare, like emptying lakes with a thimble" (*M*). "Changed my image during interval. Thought it too high and voluntarily put it down" (*B*).

Finally, there is to be mentioned the growing ability to *recognize and identify the three standards.* We see no reason to correlate this specifically with the use of the long time-interval; it may be attributed merely to the growth of special practice. *Wh*, possibly because his pre-knowledge of the actual conditions satisfied his curiosity on the point, did not develop any system of classification. *S* concluded that there were three standards or three groups of standards, perhaps two low, two high, and one in the middle. The lower standards were cold and colorless. *S* could frequently identify the standard by means of these associative tags, saying—"That 's a cold one," "That 's the warmest one," etc. This process made the test more easy of completion: "Not a good reaction because I did n't get N well identified in my scheme of standards." *M*, quite similarly, came to suppose that there were three groups of standards, with about three tones in each region. She could also frequently assign the standard to these groups correctly, *e. g.*, "That was one of the middle ones, neither high nor low; a very ordinary tone, hard to remember and discriminate. These middle tones seem more spread out, less graspable." "Sometimes the sounding of N clears up a sort of confusion which begins at the 'ready' signal [anxiety or curiosity about N]. It is like a ray of light coming through smoke. Even then, there is a fraction of an instant between hearing N as *a tone* and knowing it as *this tone*, a high one, low one, etc. This identification is quite pleasant. I often feel like 'shaking hands' with N, and saying 'Hullo, there.'"

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[1] Something of the sort was noted in Part I, *e. g.*, the double images and *Wh*, 430, 5*a*, 432, 5*a*.

Observer *B*, it is perhaps not too much to say, actually came to have an absolute pitch memory for the three standards. We say "perhaps," because the identification was of a peculiar sort. *B* did not say that a given standard was the high, middle or low one, although she thought there were three (or four) standards, but that a given tone was the one used in this or that test, usually recognizing the identity of standards in successive tests. The accuracy and the positiveness of *B*'s assertions are remarkable because often fully five minutes elapsed between the tests, and the report of the introspection sufficed completely to distract the attention from the auditory experience. Once *B* recognized V (instead of N, curiously) as identical with the V of the preceding test, but could not place it with certainty in relation to its own N. In another instance, the standard given in the eleventh test was positively identified as that given in the first test. *B* herself thinks this capacity is due to the fact that since the identification is not the object of the experiment, she is free from expectation and from the feelings of confusion incident to the task of reaction. But it should also be remembered that the identification calls for the discrimination of discrete tones only, that the three standards are 14 vibs. apart, and that there has been long practice with these same three standards. *B*'s identification of a given tone with a certain other previously experienced may still be, at bottom, a discrimination based upon an acquired absolute pitch memory of a moderate degree.[1]

A minor effect of the long time-interval is to lessen the *assurance*. "After V is 'placed' (higher or lower), I like to watch its movement for a moment to get added security." "If I have a bias for a given position of V, and it turns out otherwise, my confidence in the outcome of the whole test is shaken" (*Wh*).

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[1] *Cf.* M. Meyer, *Psych. Rev.*, VI, 1899, 514.

Series 3.

This series is a repetition of Series 1, but by the method of procedure with knowledge. The subjects knew that there were three standards, three D's, and they were told the direction, but not the amount, of the D for each test. The object was, of course, to see what effect, especially upon the expectation error, would result from the previous knowledge of the direction of V.

Quantitative Results.

TABLE VIII.

10 Second Interval. Procedure with Knowledge.

Obs.	D	V_o ||| N	m. v.	V_u ||| N	m. v.	Aver. Limit of Error.	Estimation Value of N.
M	8.4	3.08	0.86	—2.91	1.34	2.99	0.08
	11.2	5.35	1.29	—4.37	1.15	4.87	0.05
	14.0	6.30	1.20	—6.55	0.90	6.44	—0.14
B	8.4	—0.11	0.64	—1.46	0.90	0.78	—0.78
	11.2	3.02	1.43	—2.10	1.70	2.58	0.48
	14.0	3.58	2.10	—3.83	2.16	3.72	—0.14
S	8.4	0.86	1.45	1.23	2.94	0.71	0.71
	11.2	2.57	2.27	—2.01	1.60	2.29	0.28
	14.0	4.14	2.46	—1.45	2.01	2.80	0.92
Wh	8.4	—0.39	1.20	0.33	1.23	0.36	—0.06
	11.2	—0.11	1.09	—1.45	0.75	0.78	—0.78
	14.0	—0.08	2.10	—3.11	2.60	1.60	—1.60

Table VIII shows the quantitative results of Series 3. In comparing it with Table VII, one must bear in mind that the tests are relatively few in number, that the results are influenced by the increasing amount of practice, and that the procedure with knowledge is not, after all, very different from that without knowledge, for the difference lies mainly in the acquaintance with the coming position of V. Now, with the short time-interval, as we have pointed out, the observers, with the exception of *S*, had practically no difficulty in recognizing at once the position of V. In view of these facts, it is not surprising that, on the one hand, certain minor differences are observable, but that, on the other hand, the general features of Table VII are repeated in Table VIII. We are, indeed, almost repeating verbatim our résumé of Table VII when we sum up Table VIII by saying:

(1) With one exception for *B*, one exception for *S* and four for *Wh*, the 24 values indicate an error of expectation.

(2) For all observers the expectation error increases with increase of D.

(3) The mean variations are large, though, as a rule, less than in Table VII.

(4) *Wh* constantly underestimates, *S* constantly overestimates, N.

(5) All of the observers have a lower average value for the estimation of N, *i. e.*, exhibit a more accurate recognition.

The reduction of the mean variations and the increased accuracy of recognition are, we think, due to the simple growth of practice, not to the procedure with knowledge. The increase of expectation in the case of *M* is not easily explained. Possibly the procedure with knowledge engendered some carelessness, but, as will be shown presently, the contrary effect is given by other observers.

Qualitative Results.

The *general effect* of the knowledge of the coming position of V is simply, as reported by *M*, *B* and *S*, to give a feeling of security, to do away with the momentary perplexity or attentive curiosity as to whether V would be easily placed.[1] The attention, toward the end of the interval, can be kept more completely upon the image. There is greater quiet and calmness throughout the test.

Curiously enough, V does not always seem to start from the direction announced. *M* had one instance, *B* three instances and *S* two, in which, after 'higher' had been designated, V started from below or at equality. In all six cases the smallest difference was in use.

A second effect, reported by *M*, *S* and *Wh*, is the presence of an *anticipatory image of V*. *M* had this experience but once: "While my image was going on, I heard also what was to be V. I thought 'well, that 's my imagination,' and tried to attend only to N. Behold the real V matched this secondary image perfectly." *S*, who says she never hears a tone in any test which is not visualized as a spot or line at a definite point in space, and that the procedure with knowledge makes this effect clearer and more intense, very naturally visualizes the expected V, though frequently she also hears it. "In many tests, as soon as the operator says 'plus' or 'minus,' I project two spots, ne in the middle for N, one above or below it for V." "Durng the interval kept going visually from N to a lower place, ut heard only N." "This time had both auditory and visual mage of the coming V. I anticipate usually in about the same place."[1] In the case of *Wh* the anticipatory image is far more prominent and largely auditory. "There is a strong tendency to ideate V. I actually hear another tone lower or higher than N. This I usually try to repress in part by attending sharply to the image of N." This sentence is an indication of an interesting effect of the knowledge method. It looks as if, for some observers, the knowledge of the position to be taken by V might be more distracting than helpful. It frees the observer's mind from anxiety as to 'placing' V, but it thrusts upon consciousness an obsession which is still more bothersome. *S* voices this idea when she says: "I think that the expectation of a 'plus' V raised the image of N both visually and auditorily."

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[1] *Wh*, perhaps because of never feeling this anxiety very keenly, ound little difference in this regard.

Series 3 also gives us further data concerning the *method of decision*. The points brought out are to be ascribed to the influence of continued practice rather than to the method with knowledge itself. In general, each observer's report has become more settled and uniform. There are a larger percentage of tests in which the same method is described. At the same time, the differences between individual observers are more clearly defined. Thus we find that *M* never uses the amount of D as a basis for calculating the time of the reaction, and that, with her, auditory-verbal judgments are very frequent, *e. g.*, "Ah!" "There!" "'That's it," "Now," etc., etc. We find that *Wh* has settled down to a single method which is used constantly save when some accidental variation (*e. g.*, the anticipatory image just mentioned) interrupts its course. This method (practically the first main method of this observer in Series 1) is to attend with all diligence to the auditory image throughout the interval. When V begins, the image stands out sharply in contrast, but as V continues the image rapidly dies out, so that when V nears equality, the attention goes over to V and is kept there till the reaction. In the case of *B*, we find that practice has induced more caution; she attends more sharply to the image during the interval (though still to V when it comes) and attempts voluntarily to inhibit premature reactions, especially with a large D. On this account the expectation is largely reduced. Indeed, it disappears with the smallest 'plus' D.

It is of interest to note that, in contrast especially to *M*, *B* never thinks of V as fusing with the image. It could n't "because the image is in the head, the tone outside." "I never thought that the tone could have anything to do with the image." The reaction is entirely automatic: "goes off when familiarity is reached." *B* is very much bothered by periods of loudness or swelling in V; these are noted, however, only with a descending V. During these periods she is unable to react or to tell anything about the place or movement of V.[1]

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[1] When we also read that in the majority of tests, D is found to be "surprisingly small," we are led to surmise that her anticipated position is too far away from the standard, and that this process may be a source of a constant error in the reactions, though the quantitative results cannot be said to give definite indications of such an influence.

S continues to make occasional reactions based upon a bodily glow, significant of familiarity. At other times, there is a "sense of ownership:" That part of V which is like the image is 'mine,' the rest of it is 'foreign.'" There are usually two distinct tendencies to react before the finally successful tendency. These tendencies appear in a sort of rhythmic sequence, and are so related that it would be impossible to react during the interval between them. All this suggests an optimal-time factor. *S* does not, however, make reactions based upon the lapse of time as determined by the size of D. She may, like *Wh*, estimate the size of D erroneously, but usually neglects this estimate if V does not reach equality at the expected time.

Series 4.

Series 4 comprises 36 tests with a time-interval of 10 seconds, the image being eliminated, so far as possible, by distraction set up by odors. This series is, therefore, comparable to Series 1 of this Part and to Series 4 of Part II.[2]

The effects of distraction.

(1) *On the image.* The results of distraction, are, in general, similar to those recorded in Part II, although the continuous change method produces some individual variations not observed before. These variations, which are correlated with the individual variations in the method of decision, are all due, at bottom, to the continual sounding of V. To be more explicit: in Part II distraction was employed with discrete tones; if distraction was complete during the interval, the judgment was usually made without the appearance of the image. In the present series, from six to ten seconds intervene after the cessation of the distraction before the time for the decision arrives. During this period the image may very well assert itself, even if it has been successfully repressed during the time-interval proper. The possibility of this recall has been foreshadowed by our previous citations of cases in which the sounding of V "revived" the image, or caused it to "stand out in contrast."

In Table IX data are supplied showing the outcome of distraction as regards this point of the suppression of the image.

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[1] This phenomenon is entirely subjective. *S* had a few such instances with an ascending V. *Wh* was never bothered. The uneven movement in pitch, previously discussed, is quite independent of this intensive variation.

[2] See first article, 455-6, for fu

As in Table VI, four possible types of distraction are recognized: viz., (*a*), the total disappearance of the image, (*b*), momentary reappearance once (or twice) during the ten seconds without being present thereafter, (*c*), a similar momentary reappearance during the interval with a persistence into V, or another reappearance during V, and (*d*) an appearance at the first sounding of V or during its course. The fifth column gives the sum of the first two columns.

TABLE IX.

The effect of Distraction. (36 cases for each observer.)

Obs.	None	Momentarily in Interval	In Interval and at V	At or after V only	Not at V
M	17	10	4	5	27
B	27	9	0	0	36
S	19	3	2	12	22
Wh	17	5	10	4	22
Total.	80	27	16	21	107

From this Table, in comparison with Table VI of Part II, the tendencies just discussed are easily apparent: thus *Wh*, just as before, attained complete distraction in 17 cases, but, whereas before there were 17 instances of type *b*, and *none* of type *c*, the latter type is now twice as frequent as the former, while type *d* is doubled. Again, observer *S*, although reporting more instances of complete distraction, has twice as many of type *d*. All these cases show clearly this tendency of the auditory image to make its appearance at or during V under the conditions of the continuous change method.

But this tendency may be modified or entirely suppressed in the case of an observer who is not in the habit of using the image as a basis for the reaction. Thus the striking fact, that, for *B*, the image was never present at all during V, is explicable because, in the first place, *B* probably never attends as keenly to the image as do the other observers; and, in the second place, odors readily attract her attention, so that a high degree of distraction is easily produced during the time-interval. This is evinced by the 75% of cases under type *a*. And, finally, *B* does not, as a rule, make use of the image in the decision. Hence when the image is absent at the beginning of V, *B* naturally adopts the method of decision in which the attention is directed entirely to V and the reaction conditioned upon the arousal of some symbol of familiarity.

M exhibits neither the tendency of *S* and *Wh*, nor the contrary one of *B*, but the figures in her case closely correspond to [illegible] Table VI. It should be borne in mind that when ime to get adjusted to V which I never recognize immediately." Took one second to know V was going up and then got it from he movement. Took a long time to forget the smell" (*S*). Complete distraction. Took one and one-half seconds to know " (*Wh*).

(4) *On the method of decision*. In our discussion of the effects of istraction upon the image, we have already foreshadowed its ffects upon the method of decision. In general, we may say at complete distraction compels those observers who formerly ade use of the image to resort to the other chief method, that f attending to V and reacting to familiarity of some sort. Now, nce *B* naturally used this method, her introspection may be ismissed herewith, as bringing out nothing essentially new. *f* shows the correlation clearly; with complete distraction she ttends to V "until N seems to be sounding again." "Fine istraction; no image; matched where N was." If, on the ther hand, the image is clearly present during V, it becomes he object of attention and is used as a standard. There is, too, sort of intermediate type. "If I have the image at all during he interval, I am half-way ready for V."

Wh, who uniformly used the image whenever possible, preented, as we saw, two main types of distraction, viz: *a* and *c*. His method of decision consequently was of two distinct sorts, nuch akin to those of *M*, but even more clearly demarcated, as the ollowing instances will show. Type *a*. "Complete distraction, placed by its own movement; no idea of pitch or place of N, eaction absolute guess-work, touched off by the merest trace of resemblance." "Knew V at once as lower, but had no idea *how much* lower."[1] "Reaction came as a sort of despair." Type *c*: "If the image has been present at any moment during the time-interval, it is more apt to emerge during V. Even if not, it at any rate seems to 'fix' N, so that the reaction is much more easily and confidently made." "Image back a moment about the middle of the interval and also at V, so that it gave a basis for the reaction." Between these two main types there are, as with observer *M*, intermediate varieties which are interesting from the light they throw upon the others; *e. g.*, "Distraction good, though possibly the image was on the verge of reappearance once. Judgment uncertain, but less so than in ome. Had general idea (auditory-verbal) 'wide D,' but no oncrete idea as to how wide this one was." Here one may

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The same report is often given by *B*. These cases are instructive en compared to similar instances in the discrete experiments when s cognized as absolutely 'high' or 'low,' but not as 'higher' or er' than any standard. Note that there such knowledge sufficed oduce a successful judgment; here it is of no avail in determining cessful reaction, for the *how much* is all important.

suppose that the faint re-establishment of N was sufficient arouse the general idea "wide D," but not sufficient to rela N and V more definitely. The assurance is likewise of an i termediate grade.

When distraction is complete, *S* often characterizes her rea tion as "wild," "vague," "quite in the air," etc. In suc cases the reaction is determined by some vague feeling of fami larity : "V stands out visually." But frequently, perhaps in th majority of these cases, *S* has a visual-spatial idea of the place V in relation to N; *e. g.*, "Image not present at all, but I had general estimation : let V go about so far,—half way down or t the middle of the screen where N is put."[1] "Reacted to vagu idea of place." "Have a vague feeling of the amount of D. Least frequent is a type of decision similar to that of *M*. "Tr to see a clue to the image in each 'tone' of V." This is, course, in contrast to her general method of keeping the image i attention and trying to find something like it in V. Occasionall *S* entirely fails to react, but simply exclaims: "I don't kno anything about it."

(5) *On the assurance.* Distraction, like a long time-interva lessens assurance.[2] This is especially true for observers *M* an *Wh.* *B*, who makes little use of the image generally, is als less certain under distraction. *Wh.* is the more uncertain, th greater the distraction, yet "none of these results are quite satisfactory as if there was no odor at all to distract." "Th image in the continuous change experiments is so useful to m that any weakening of it makes the decision less assured." Ver many of the reactions which seem most doubtful to the observe are relatively accurate objectively; in other words, assuranc and accuracy do not vary in common. Good reactions are made not only when the observer pronounces them definitely bad, bu also when the observer is "utterly at sea" and knows nothin about the reaction. The explanation of this will appear in moment.

(6) *On the quantitative results.* In Table X will be foun the quantitative results for Series 4. The effects of distraction as we have already intimated, vary with the observer.

Let us first take the results for observer *B*, who, it will b remembered, was relatively little affected by distraction becaus her normal method of decision involved attention to V wit little or no attempt to relate it definitely with the image. He results in the present Table are practically identical with thos

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[1] To make this intelligible, it should be explained that *S* habituall sat with her right ear toward the source of sound, and hence facing th cardboard screen (first article, 417) upon which she projected her vi ualizations of the tones.

[2] *Cf.* first article, 456.

TABLE X.

10 Seconds Interval, with Distraction.

Obs.	D	V_o ‖‖ N	m. v.	V_u ‖‖ N	m. v.	Aver. Limit of Error.	Estimation Value of N.
M	8.4	—0.35	2.24	—2.06	1.37	1.20	—1.20
	11.2	0.64	1.37	—0.37	1.12	0.50	0.14
	14.0	1.29	3.02	—4.28	2.71	2.79	—1.50
B	8.4	1.90	1.23	—1.93	1.85	1.92	—0.02
	11.2	3.53	1.48	—3.33	0.53	3.43	0.10
	14.0	4.48	1.65	—6.41	0.87	5.45	—0.97
S	8.4	—2.44	1.20	5.88	1.76	4.16	1.72
	11.2	—3.36	1.26	3.05	2.01	3.20	—0.16
	14.0	0.53	0.73	0.28	2.69	0.40	0.13
Wh	8.4	—1.88	1.40	2.43	2.27	2.16	0.28
	11.2	0.28	0.92	—0.22	1.76	0.25	0.03
	14.0	0.14	1.06	0.20	2.80	0.17	0.17

of Table VII, save that the size of the expectation error is slightly reduced.[1] This general reduction may be due either (1) to a slight caution, born of practice, or (2) to the slight 'gap,' above mentioned, between the odor consciousness and the tone consciousness.

The results for *S* and *Wh* are likewise correlated directly with what the introspection had indicated as the effects of distraction. Both of these observers felt keenly the loss of the image (*Wh* of the auditory image, *S* of the auditory image and of the opportunity to identify N visually and otherwise), and it is reasonable to suppose that its loss minimized the expectation error, for if there is not in consciousness a certain definite place which V is expected to reach, there is an absence of material for expectation.[2] This factor is, now, supplemented by the influence of the 'gap,' which is of longer duration for *S* and *Wh* than for *B*. Finally, *S* and *Wh*, in their confusion at the loss of the standard, turn to V for some indication of familiarity, and are apt to wait too long in this effort to gain

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[1] The reduction was, on the whole, more apparent with a descending variable (just why cannot be stated), so that the estimation value of N has changed its sign with the smallest and the largest D. But this change is insignificant; the values have actually changed but little, and are, all of them, less than one vibration in amount.

[2] It may be objected that *B* ought, on this line of argument, to show no expectation error. But *B* adopted her method of decision quite naturally, whereas *S* and *Wh* in the present series are thrown upon this method which is foreign to their natural procedure. Moreover *B*, as we have explained at some length, is influenced by an habitual-time factor which produces an expectation error.

"some clue to N." Whether these three are the essential or the sole factors involved, the fact that the expectation error is very materially broken up is very patent from the Table. Note especially the reversal of the sign of the error in five out of six cases for *S*, and half the cases for *Wh*, and, more striking yet, the complete reversal of the rule that the average limit of error increases as D increases.

M, as might again be predicted from the introspection, occupies an intermediate position between *B* on the one hand and *S* and *Wh* on the other. There is a single change of sign and the progression of the average limit of error is partially destroyed.

RÉSUMÉ OF PART III.

In Part III we have continued our examination of the problem set forth in the title, giving special attention, however, to the second phase of the question, *i. e.*, to the structural analysis of the consciousness present in the functions of discrimination and recognition.

All the experiments of Part III were made by what we may term the method of reaction or the method of continuous change; its essential feature was the use of a continuously sounding variable which moved from above or from below the standard toward this standard at a uniform rate until arrested by the observer at subjective equality. Four series were conducted: Series 1, ten seconds time-interval, image held; Series 2, 40 seconds interval, image held; Series 3, ten seconds interval, procedure with knowledge, image held; Series 4, ten seconds interval, image lapsing with the aid of artificial distraction.

The quantitative results of these four series are best gleaned from Tables VII to X.

The qualitative results (largely gained from the introspection) are given below in general outline. It should be understood that, owing to the extremely individual character of the treatment of the results (a character which it has been the aim of this thesis to exploit), such a summary is at best merely a very rough outline of the more striking facts which are common to most of the observers. The individual variations which have been discussed at length in the text are, in our opinion, psychologically even more important than any number of generalizations.

(1) Some observers are able to classify and identify the standards in use by auditory-verbal, visual and other associative supplementing. This process is apparently helpful in the reaction.

(2) The variable tone seems to move toward N by stages

which may be regular or irregular. The movement is frequently visualized, and observers have distinct emotional preferences, some for an ascending, some for a descending, tone. The direction of movement is frequently misinterpreted, and illusory movements appear even during the procedure with knowledge.

(3) The method and basis of the decision is distinctly an individual matter; we may, however, distinguish certain types. The attention may be directed (1) upon the image, (2) upon the variable, or (3) alternately upon the image and the variable. (1) When the attention is upon the image, the decision results from the appearance in the variable of a tone (or visual substitute) which 'matches' the image. (2) When the attention is upon the variable, the decision results (*a*) from the appearance of some tone or 'place' in the variable which resembles the standard (whether the image is recalled or not), (*b*) from some subjective change in the intensity, timbre or movement of the variable, or (*c*) from some change felt in the observer's body which is indicative of familiarity. (3) Attention of the alternating type, in so far as it involves a series of auditory comparisons between the image and the variable, is present only in the early tests before the observers attain practice: a form of alternating attention not involving comparison (a single shift from the image to the variable when near equality) is also used by some observers occasionally. Still other decisions are the result of an inference, based upon the size of D, as to the time required to reach equality. Finally, some decisions are not recognitions at all, but mere guesses set off without regard to the actual tonal relations.

(4) The movement of reaction (finger-key) becomes automatic for all observers, though much sooner for some than for others.

(5) After the reaction there is heard a distinct additional movement of the variable which we have termed the 'after-tone;' some observers make use of this to evaluate their reactions.

(6) There is a strong tendency to react too soon; in other words, an error of expectation. This is fostered by several contributory factors, but partially counteracted with varying success by conscious attempts at restraint.

(7) Expectation increases as D increases, save for some observers when under distraction.

(8) No observer can say definitely that a given reaction is exactly correct. Reactions possess merely a varying degree of satisfaction. There is an area, rather than a point, of equality.

(9) Procedure with knowledge of the position of the coming

variable has little effect upon the quantitative results. It merely gives a sense of security to those observers who had occasional difficulty in apprehending at once the position of the variable. On the other hand, there is a tendency to be obsessed by an anticipatory image of the variable,—a tendency which may be a source of some disturbance.

(10) The long time-interval produces irregular quantitative results, owing largely to its deleterious effect upon the image. It is helpful to have the image persist in some form through the interval, so that the amount of D at least may be used as a basis for the reaction; but it is possible to make objectively satisfactory reactions when the image has been permanently lost before the sounding of the variable. Such decisions are usually based upon 'familiarity feels,' and are subjectively quite unsatisfactory to observers accustomed to the use of the image. Difficulties in the apprehension of the position and movement of the variable, which are increased by the long time-interval, confirm a previous assertion that there is a tendency to sharp the image with long times.

(11) Distraction by odors is successful in the majority of instances, though observers using the image in the decision are more apt, with the continuous change method, to have the image in consciousness during the decision. Distraction interferes with the process of identifying the standard, and renders the apprehension of the position of the variable more difficult; there is a distinct gap between the odor consciousness and the tone consciousness. Complete distraction compels all observers to attend to the variable and to react without reference to an image. All observers have less assurance. Those addicted to the use of the image no longer exhibit an expectation error.

(12) Practice lessens the mean variation, and unifies the course of the reaction consciousness of each observer, though, at the same time, individual differences are accentuated.

(13) The method of reaction, since it calls, so to speak, for a 'quantitative' as well as a 'qualitative' discrimination, leads to certain results quite different from those of the tests with discrete tones. Most important is the fact that observers who excelled in the discrimination of discrete tones without the use of the auditory image find the reaction to auditory equality is most satisfactorily accomplished by the keenest attention to the standard and the use of the auditory image as a basis for the reaction.

PART IV.

Miscellaneous tests.

The miscellaneous tests of Part IV deal with points raised during the previous experiments, especially those with discrete stimuli in Parts I and II. Of these tests, those involving the associations of color to tones have already been discussed.[1] There remain to be mentioned the pneumographic tests, the drawings of the movement of continuous tones and the chronometric measurements of the judgment-time.

The *tracings of respiration*, obtained under various conditions by means of a Verdin pneumograph and a continuous-paper kymograph driven noiselessly by a distant water-motor, failed to establish any very instructive correlations. The one obvious result worthy of mention was that shallow and irregular breathing ensued whenever the attention was sharply concentrated,[2] as, for example, in the endeavor to bring back an image clearly just before V, or, better yet, in the reaction-consciousness, where, as we have already pointed out, there was nearly always visible excitement and a high degree of expectant attention.

The *drawings of the movement of the variable tone* used in the continuous-change method were made partly to elucidate the general nature of the subjective movement of the variable, but in particular to see how far the visualizations reported by observer *S* could be objectively recorded. At first, in accordance with the suggestion of Stern,[3] we tried to register these movements by means of the kymograph above mentioned. The observer rested her wrist upon a smooth metal rod fastened horizontally parallel to the plane of the paper. A cardboard screen, in which was cut a narrow slit the length of the width of the paper, was then attached to the apparatus just above the paper: the object of this screen was to allow the observer to trace the movement of the tone with a pen, the point of which was free to move to the right or left along the slit, while at the same time, the tracing was covered up as fast as it was made. A time-marker gave the requisite control. The tests then proceeded in the following manner. When N sounded, *S* touched the paper for a moment to indicate the place (visually and spatially) of the standard; when V sounded, *S* again placed the pen upon the moving paper at the right or left, for a 'plus' or 'minus' D respectively, and then moved her hand in toward the center of the strip just as V seemed to her to move, taking the pen off when she thought V reached the position (auditorily and visually) taken by N. This method of procedure was at first reported to be quite natural and easy, though the movement from right to left was less natural than the opposite one. As the experiments continued, however, objections appeared. To begin with, there was so much for the observer to think about, the starting of the machine, execution of the drawing, making the reaction, etc., that procedure without knowledge of the position of the coming V (always more difficult for *S*) had to be given up. Finally *S* was never satisfied with the resulting curves; the ordinates were not commensurate with the actually experienced tonal 'slumps,' so that the curves represented little but the number and frequency of the 'steps' taken by the tone. Accordingly, at the observer's suggestion, the moving paper device was given up. In its place the following method was adopted. With closed eyes, *S* indicated the place of N, and the starting point and entire movement of V, upon a stationary sheet of paper. The results were entirely adequate representations of the spatial behavior of the tones.

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[1] First article, 420; also this *Journal*, X, 1900, 318.

[2] *Cf.* the results lately attained by P. Zoneff and E. Meumann (*Phil. Stud.*, XVIII, 1901, 1-113) who say (p. 44) "Alle diese Angaben . . . . führen zu der Annahme, dass eine willkurliche Concentration der Aufmerksamkeit eine Verlangsamung des Pulses und eine Hemmung der Athmung bewirkt."

[3] *Veränderungsauffassung*, 117.

It is rather difficult to describe these drawings briefly. To begin with, N is almost always identified as one of a series of standards, this series consisting of six or seven round, grayish spots. The whole series is not seen at once, but merely the two or three spots in the region of N.[1] But the actual N is not only identified as one of these gray spots; it is always manifested as a horizontal line about three-fourths of an inch long, moving from left to right. The variable starts at a point in space about four inches to the right[2] and four or five inches above or below the place of the standard. When above, it descends vertically, but when below, it rises obliquely to the left. In either case, the movement is such that the gray ball representing V executes a series of curves with the result that, on the side toward *S*, *i. e.*, on the left (naturally the only visible) side, a gray rope is formed, whose outline is an index of the number and nature of the slurs in the movement of V. The actual number is a very uniform function of the time consumed by the tone; each slur representing two seconds, *e. g.*, when D = 14.0 vibs. (ten seconds necessary to reach equality) five slurs would be drawn. Finally it was found, much to the surprise of *S*, that the stopping point of the tracing of V (subjective equality) was almost invariably exactly opposite the point at which N had been placed, this giving a most striking confirmation of the vividness and distinctness of the visualizations, and of the readiness with which they might serve in the determination of the reaction.

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[1] We have noted that *S* thought, at first, that there were six or seven, later, three or four standards. Apparently, she finally came to classify correctly into a high, medium and low *region*, only she thought that each region contained several tones.

[2] This distance is more or less arbitrary; occasionally it is shorter.

The recognition-time in immediate judgments. In Parts I and II it was clearly demonstrated that, under the conditions of our experiments (8 vibs. D, with three possible judgments, etc.), the variable stimulus could be recognized as the same as, or as higher or lower than, the standard, in a very brief time after the sounding of the variable; this though the time-interval were 2 or 60 seconds. The introspection bore out this observation, for it was evident that these judgments were made without any process of comparison between the variable stimulus and the image of the standard; they could be made when all trace of the image was removed by suitable distraction during the interval. We termed these judgments *immediate*, meaning that no comparison was present, whether or not there was at the moment any trace of the auditory image in consciousness. That, within the judgments thus classed as immediate, there might be differences in the actual rapidity of the decision has been definitely stated.[1] It now remains to be seen whether these judgments are actually as rapid as the introspective reports indicate, and whether they are fast enough to warrant the conclusion that it would be impossible to have in the consciousness under measurement any process, however fleeting, involving reference to the image.

In order to investigate these points, the following arrangements were made. The air-cock of the blown bottle apparatus was equipped with metal contacts such that a circuit passing by way of a lip-key to a Hipp chronoscope was completed as soon as the air-cock was opened far enough to produce an audible tone from the bottle.[2] Observers *M*, *B* and *Wh* were then practiced in the use of the lip-key and the, at first rather difficult, task of expressing their judgments audibly. Advantage was taken incidentally to secure what we may call the 'speaking-times,' *i. e.*, the time necessary to pronounce the judgment words, 'higher,' 'lower,' 'same,' etc.,[1] in response to a single isolated tone, the actual conditions of the experiment thus being in play, with the exception that no standard was given, and that the time measured was, therefore, a single perception-time instead of a recognition-time.

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[1] For example, first article, 443, 3.

[2] It is to be noted that this arrangement is open to a slight error, for, in actual operation, the air-cock is opened suddenly to its full extent so that contact must be made slightly before the current of air has rushed through the four feet or so of tube and set the bottle in action. This, error, however, is very slight, and the form of apparatus used was the most feasible of several that were tried. Moreover, the error, whatever its size may be, lengthens the reaction-time, and hence cannot be construed as contributing to the advantage of the results sought.

The figures in Table XI represent introspectively valid tests only, those in which the judgments are rated by the observer as correct and immediate. From this Table we wish to make simply the following points, both of which are in complete accord with the introspective evidence already given.

TABLE XI.*

(*Recognition-Times. All results in sigma.*)

Obs.	Cases	D=+8	m. v.	D=0	m. v.	D=−8	m. v.
M	4	657	46	849	37	787	47
	6	407	48	402	49	341	42
B	4	464	99	659	70	609	56
	5	312	63	315	56	384	96
Wh	8	754	101	815	87	709	55
	6	317	36	350	27	294	21

* For each observer the first line represents the recognition-times, the second line the simple reaction.

(1) The recognition of tonal equality or specific difference can be given verbally in about three-quarters of a second. Hence, under the conditions of our tests, judgment is complete before the variable ceases to sound.

(2) Difference and its direction are more quickly recognized than equality.

One is tempted to carry the interpretation of the results still farther, to show, *e. g.*, that the relative speed of judgments of higher and lower in the case of *B* is in accord with her introspective verdict that 'higher' is the easiest and quickest judgment, and that it is to be related to the tendency to pass that judgment.[2] But the cases are very few in number and the mean variations are large. Even after the preliminary pracice it was rather curiously difficult to secure a satisfactory eries; a half-dozen tests were sometimes necessary to secure a ngle entirely valid result.[1] Of interest, finally, are the times f a few incidental judgments in which the observer was unertain. The correlation of uncertainty with slow rates is early shown for in all these instances the times are over one econd.

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[1] The observers had strong preferences for the particular word which they used for the judgment, so that it was thought best not to insist upon uniformity in this respect: accordingly *M* used 'higher,' 'qual,' 'lower;' *B* 'high,' 'sa-' (for same), 'low;' while *Wh* used igher,' 'equal,' 'lower.'

First article, 450.

The chronometric tests, then, give objective verification to ur assertion that immediate judgments are made so rapidly as o exclude the possibility of the process of image-comparison.

CHAPTER III.

CONCLUSIONS AND THEORETICAL IMPLICATIONS.

To gather together all the principal results of our investigaion into brief compass, and, at the same time, to allow each tem its proper significance is quite out of the question. Most f the results were obtained under specific conditions, and hould not be stated baldly without reference to those condiions. The reader is accordingly referred to those portions of ur text in which summaries and conclusions have already een given: most important are,—for the quantitative results, first article, 421, 422, present article, 223-4, 243-4, 250-1; for the qualitative results, first article, 443-6, 448, 455-6, present article, 230, 239, 252-4.

While we keep these specific conclusions in mind, we may venture, however, to discuss the outcome of our investigation, taken as a whole, upon the two problems set forth in the introduction,—the nature of the memory image for tones, and the nature of the consciousness involved in the judgment or decision.

THE NATURE AND COURSE OF THE IMAGE.

In regard to the nature and course of the memory image of both clangs and tones, we may conclude that:

(1) The auditory image is but one part of a complex structure which represents the original experience. Put briefly: the memory image of a tone is not a tonal memory image; it is that and much more. A tone is held in memory not only as an auditory quality, but also as a definite quality, possessing marks which help to identify it. These marks of identifica-

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[1] Some of the difficulties are indicated by the following quotations: "Possibly opened lips too soon." "Said 'same' instead of 'equal.'" "Hesitated slightly for word." "Completely rattled: too anxious to make a quick decision." "Opened lips before I said the word." "Tendency to say 'equal,' then said 'higher.'" "Slow judgment." "Not sure of judgment." "'Equal' judgments naturally need the verbal expression to 'cap' them, but 'higher' and 'lower' I know before I can speak the word. Not natural for me to put the verbal sign on till later."

tively between judgments of identity and judgments of difference, and, again, between simple judgments of difference without direction, and definite judgments of a difference and its direction.[1]

We must further note (2) that the values yielded by the reaction method, on account of the peculiar conditions which we have attempted to analyze, cannot be compared off-hand with those obtained by right and wrong cases. We cannot even say that the determination of subjective equality in the former method is akin to the judgment of equality in the latter. Yet, despite these radical differences, both methods furnish us with data which admit of unification in generalizations as to the mechanism of judgment.[2]

The following conclusions summarize the evidence we have obtained in regard to the structure of the judgment consciousness.

(1) The presence of the auditory image is not necessary to the recognition of either difference or equality. Judgments without the slightest trace of comparison were so frequent as to be the prevailing type for most observers. Their existence is attested by the introspection of the observers, by the tests made under distraction and by the chronometric measurement of recognition-times.

(2) The auditory image may be present in the judgment consciousness, but not itself an object of attention, not serving as a basis for comparison.

(*a*) This is most common in judgments of identity, when, although the recognition is immediate, the variable tone seems to re-enforce, or flow into, the image. Two interesting questions arise here: is the presence of such an image useful? Again, is it possible that its absence is the cause of the rapid decline of right cases for D = o, as time-interval increases? The fact of this decline is clearly established: it was found by Angell and Harwood and by Wolfe. That long time-intervals seriously affect the auditory image is equally definitely made out. Let us, then, consider this question first.

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[1] It is clear that this division disregards the distinction between right and wrong cases: judgments of difference might be given with objective equality, etc. But the errors have already been discussed; for present purposes our immediate object is to deal with the right cases only.

[2] It may possibly be objected that the term 'judgment' cannot properly be applied to the reactions of the continuous change method or to the flash-like immediate answers in the case of discrete tones, on account of their simplicity and semi-automatic nature. J. Royce (*Psych. Rev.*, IX, 1902) seems to imply that Marbe's experiments (*Experimentell-psychologische Untersuchungen über das Urteil*, Leipzig, 1901) are open to this objection, for, after stating that Marbe undertook to investigate the psychology of the judgment, he says (115): "therefore it was the experimenter and not the subject in whom the process that was to be studied went on." We must, however, remember that mind is full of short cuts, that mental processes follow psychological courses rather than logical patterns. The experimentalist must work at first upon the analysis of comparatively simple bits of content; *cf.* our recommendation below, p. 268.

One must bear in mind that long time-intervals affect the image in several different ways; its pitch, its clearness and its intensity, all are influenced. Now, though we have just stated that the image suffers least in pitch, it is, nevertheless, evident that a slight change just here would be most disastrous to the successful execution of *qualitative* discrimination. We have, as a matter of fact, been several times forced to take cognizance of the tendency to sharp the image, and we have shown definitely[1] that this tendency, as manifested by the error of judging — instead of = (and possibly, also, that of = instead of +, though the conditions are there rather different), is markedly increased by long time-intervals. In other words, the effect of time-interval upon right cases is largely due to the sharping of the memory image (including both auditory and supplementary components) rather than to its absence. Further discussion of this point would, therefore, lead us into the matter of judgments of higher and lower, and this we must defer to a later point.

The first question still remains:—is the auditory image which is merely present and not the object of attention, at all useful in those judgments of equality which are *correct?* We are of the opinion that, on account of its not being a direct object of attention, the image in these cases forms simply one feature in the 'familiarity feel,' which, as we shall try to show in a moment, is, in part, characterized by the ready provocability of centrally excited sensations. If the particular pitch which is recognized happens, when V sounds, to be actually in process of central excitation in the form of an auditory image of the standard, then the recognition is, in all probability, aided by this fact. The ease of the reception of the variable stimulus is distinctly enhanced, and the variable is then, for the observer, recognized as the *same tone* as N, rather than as merely familiar.

(*b*) In judgments of difference, likewise, the image may be esent when the variable sounds, but it is then almost inriably thrust out of consciousness by the direction of the attion to the variable, and the judgment is determined for the st part by other factors. The advantage of the persistence the image into the beginning only of the variable, in the retion method, constitutes a special case. The image is not ien present in the judgment proper; it is merely an accessory o a preliminary judgment of the position of the variable at the tart. Here it seems to aid some observers who react in terms f elapsed time, to make a more definite notion of the amount f D.

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[1] First article, 422, 2 (*b*).

(3) The auditory image may be an essential component of he judgment consciousness, becoming a direct object of the ttention, after the attention has once been given to the varia-le. Such judgments exhibit a true process of comparison.

(*a*) When working with discrete tones, judgments by com-arison appear in cases of difficulty, when the conditions are ovel, when the variable fails to touch off the decision at once, vhen two contradictory impulses are felt. In short, the delib-rate use of the image as a standard of comparison is a more omplicated device, a round-about path, indicative of obsta-les, uncertainty and hesitancy. Its results, moreover, are themselves uncertain and quite as likely to be wrong as right.

(*b*) When working with continuously changing tones, the auditory image may be, even for observers who entirely neglected it with discrete tones, the object of constant attention, the standard to which the variable is compared,—whether by a series of rapid alternations of attention, or by active attention to the image (the variable itself being, since peripherally excited, sufficiently insistent without attention). This apparent change in the function of the image is but apparent. The conditions of the reaction method demand an exact identification of the variable and the standard, not a simple choice of one out of two or three possible answers. We have frequently shown that the reaction was felt to be merely an approximation, and that there was never absolute certainty. Now all this is tantamount to saying that the reaction calls for a very careful discrimination. This is more difficult, and hence it is not surprising that some observers make the fullest use of the memorial representation of the standard.

We have already mentioned, also, that, in many cases, the auditory image received attention up to the time the variable sounded in order to get a more exact determination of the amount of D, and hence to furnish indirectly a basis for the execution of a reaction at the expiration of a definite time-period.

We must now consider cases (1) and (2), especially the former, more fully, and seek to show what replaces the auditory image as the basis of judgment. Two main types must be explained, viz.: positive judgments of 'higher' and 'lower,' and judgments of identity. We may then discuss, finally, judgments of difference only, which may or may not involve the image.

4. Judgments of 'higher' and 'lower,' made without conscious reference to the image, are largely analyzable into com-

plexes of strain sensations, with less prominent visual and organic elements, set free neurologically by the variable stimulus. The two chief factors, feelings of tightening and relaxation for 'higher' and 'lower' respectively, were reported throughout the tests with discrete tones, and were also well brought out with the wide differences used in the reaction method. We believe that these strains, which are especially noticeable in the chest, throat, eyebrows, scalp, and about the ears, are explicable as symbols for 'upness' and 'downness' in the tonal continuum set up by every-day experience, especially in executing and listening to music. Of course, it is impossible actually to differentiate innervations of the vocal cords within the small limits of tonal differences employed (the maximum D with discrete tones being less than ⅛ of a whole tone), yet the variable stimulus may arouse a complex of sensations,—partly centrally, partly peripherally excited,—which means simply '*high*' or '*low*.'

For certain observers who are extremely visually minded, the visual features set up by the stimuli may play a more important part than the strain sensations. The actual muscles concerned in mediating the strain sensations are also quite different for the different observers, but the general fact exemplified throughout is that judgments of 'higher' and 'lower' are usually mediated by the associated or supplementary components of the consciousness set up by the variable. Strain sensations seem to be, *par excellence*, the symbols of rise and fall in the tonal continuum.

The reasonableness of this explanation is, we think, attested very definitely by occasional instances in which imagery more specifically associated with the tonal scale was the deciding element in the judgment. The instances referred to are visualizations of a printed musical scale, of a piano key-board, the kinaesthetic imagery of striking one piano note a half tone above another, etc.

(5) Judgments of equality or identity without the presence and use of the auditory image are, as we have said, not so frequent as judgments of difference. When working with discrete tones, V is apt to bring up the image of N, though equality may be immediately recognized without comparison. We have intimated that in these cases the image simply became one part of the familiarity feel. We have now to consider more fully the nature of this feel, and to take into account, especially, judgments of equality in which the auditory image is entirely absent, (*e. g.*, with long intervals and distraction in the case of discrete tones, and with both these and the cases of observers who attend to V, in the reaction method).

Both of these types of judgment present clearly the problem of the *familiarity feel*, since in both types, there is absence of any image and of the process of comparison. What is the structure, then, of the familiarity feel? Most pertinent in this connection are the continuous change experiments, for every reaction is an indication of equality. Discarding all tests in which an image of N was present, we find that the remainder may be placed in two groups, according as to whether familiarity was based (*a*) upon some subjective indication in the variable tone itself, or (*b*) upon some general indication afforded by the observer's own body.

The indications of the first type are exemplified by the following phrases culled from the introspection: the variable at equality is said to be,—graspable, appealing, more noticeable, louder, stronger, lingering along, standing out, a warmer gray, rounded-up visually, splayed out, etc. It is evident that many of these modifications of the variable refer to other than auditory features; thus, the first is tactual, the last four obviously visual. We are again reminded of the prominence of the associated and supplementary components of the auditory experience which were in evidence in judgments of 'higher' and 'lower.' It may be supposed, then, that the standard arouses a more or less definite complex of sensations, and that when the variable stimulus arouses the same, or a closely similar, content, the identification is affected. In other words, that point of the variable stimulus is familiar which has a peculiar effectiveness for the arousal of centrally excited sensations.[1] Such phrases as 'appealing' and 'my tone' indicate very obviously that the identified tonal quality is, if one may use the the term, peculiarly 'apperceptible.'

The indications in the second type are much less varied in nature and much less frequent in occurrence. Typical experiences are given in the phrases:—"glow of warmth," "kind of jumped all over," "felt a sense of ownership." These experiences seem always tinged with more or less pleasantness. They remind us of the pleasant "mood of feeling at home" which has often been attributed to the recognitory consciousness.[2] It is to be noted that, in common with the familiarity marks of the first type, these indications are components of the associative fringe which gathers about the auditory core and serves to give it individuality and identity. On the other hand, these components must be different in origin. The changes felt in the tone serve to identify that particular experience. But the general bodily reaction stands for familiarity in general; the variable is not the-same-as-N, but simply familiar. Such a reaction might identify as familiar, experiences quite other than those with which we have been concerned. Indeed, one would be very much more likely to experience the 'glow' of familiarity in situations in which the content of the experience had more complexity, more interest and vital importance than can be instilled into laboratory tests in the recognition of pitches.

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[1] *Cf.* Külpe, *Outlines of Psych.* New York, 1895, 172; Titchener, *An Outline of Psych.*, New York, 1899, 274.

[2] *E. g.*, Külpe, *op. cit.*, 172 ff; Titchener, *op. cit.*, 274 ff. The term 'mood' is, we think, rather objectionable as it connotes, to use the latter author's terms (241), "the weaker emotive states which persist for some time together." The affective reaction present in our recognitions may be very short-lived. On the other hand the term 'mood' has the distinct advantage of indicating the origin of the feeling of familiarity, since it refers us to an emotion as the primary source, and thus gives a biological explanation for the experience. There should be something in our terminology to indicate the distinction between such 'weakened' and 'degenerated' feelings and other feelings which are not the products of this line of development. Possibly the term 'secondary feelings,' on the analogy of the secondary reflexes, might serve to distinguish

Finally, recognitions of familiarity were not, at times, analyzable to the extent just described. The first thing to appear may be merely some auditory-verbal reaction,—perhaps the words 'equal' or 'same,' or, in the reaction method, the phrases 'that 's it,' 'now 's the time,' etc. In these cases we think the explanation is simple. The relatively complex content which marks more definite identification is replaced by merely the word content, 'known.' In all probability, even such recognitions are not made indifferently. We may suppose that the feeling of 'at-homeness' is also weakly present. The conditions of experimentation, however, lead the observer's attention to the verbal formulation, and the other features escape notice in that particular judgment. We have already called attention to the one-sidedness of individual bits of introspection. If we admit, then, that the cases under consideration exhibit both the auditory-verbal 'known' and a weak feeling of ease, we have shown enough to explain the execution of the judgment. A good analogy, which shows how the auditory-verbal consciousness may represent what was once more complex, is to be found in the development of cutaneous local signature, where the marks of locality, once, in every probability, made up of a complex of pressure-strain-articular-muscular sensations, became visual, and, ultimately, auditory-verbal.

Now the familiarity mark is quite as difficult of analysis as the locality mark, so that when we have procured, as in the present study, several thousand introspective analyses, we are warranted in assuming that the evidence of the majority of the cases, taken together, is most illuminative, and that, in the light of this evidence, those cases in which introspection fails to discover all the customary marks of familiarity, and, too,

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these from the others which might then be termed the 'primary feelings.'

those cases in which introspection fails to reveal any trace of the mechanism whatever (*i. e.*, in which the tones is simply familiar, and that is all), that these cases are not to be mistaken as evidence for the unanalyzability of the familiarity feel, but rather of the limitations of the particular bits of introspection involved. We are not compelled to assume an unanalyzable 'quality of knownness' (Höffding), or an irreducible attribute of centrally excited sensations (Washburn).

(6) Judgments of difference in which the direction of the difference is unknown are quite common for some observers. They rarely appear except when there is an actual objective difference.

To explain them it must first be noted that they are of different types. We may distinguish at least three.

(*a*) Those involving the process of comparison and the use of the auditory image. This type is found in the case of observers who make most use of comparison (*e. g.*, *W*). The attention alternates several times between the two images,—that of N and that of V,— until the identity of the two becomes confused, so that the observer knows that one is higher, but cannot tell whether it is the image of N or of V.

(*b*) Those in which there is no comparison and no use of the image. Judgment results from a 'motor' or visual 'shift' set up by V, only this reaction is not definite like that symbolic of 'high' or 'low;' it simply indicates a change or difference. The possibility that a stimulus can reproduce the judgment of difference without producing a more definite judgment of the direction of the difference has been frequently stated. The explanation given by Külpe[1] and by Stern[2] seems quite adequate in the present connection. Finally, we may distinguish a third type.

(*c*) Those in which judgment does not stop at the assertion of difference as in (*b*), but in which the direction of the difference is afterwards successfully ascertained by voluntarily "hauling up" the image of N and performing the process of comparison.

This completes our problem. We have endeavored to present an exhaustive analytical investigation, with the aid of two distinct experimental methods, of the mental processes involved in the discrimination of simple tones and clangs as conditioned by time-interval and by the mental constitution of the observer. We have endeavored finally to express in as compact a manner as possible the generalizations of the facts adduced and the theoretical significance of these generalizations.

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[1] *Op. cit.*, 173 f.

[2] *Veränderungsauffassung*, 251.

Certain problems have appeared in the course of the investigation which might well receive further discussion and further investigation. We have, for example, been impressed with the prominence of the spatial characteristics of tones. While we cannot here amplify the proposition, we may assert that, in the light of our introspective evidence, there is nothing immanently or innately spatial about tones; that all their spatial characteristics are secondary and supplementary, the product of experience with very special emphasis upon the spatial characteristics of the source of the sound.

Another problem which would be suitable for experimental investigation, and closely related to our own subject is to be found in the recognition and discrimination of auditory qualities whose pitch (at least that of the standard) is not that of a single isolated note, but that of a cadence or melody, or of a chord. Such a content would present conditions more nearly resembling those of actual life. The mechanism of recognition might conceivably be more complex, but at the same time more open to view. The influence of absolute pitch, of musical training, of the nature of the imagery, would all be more apparent than in the case of isolated tones. From the writer's own experience it seems probable, also, that such tests might be made with time-intervals greater than those here employed.[1] The point of attack must be throughout qualitative (though fidelity of memory, or, to speak more strictly, capacity of recognition, might be incidentally determined), and great attention must be paid to the peculiarities of individual observers.

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[1] *Cf.* Stern, *Veränderungsauffassung*, 206, "Für einen einzelnen Ton ist die Reproducierbarkeit zeitlich eine viel beschränktere, als für den Klang einer Stimme oder für eine Melodie."

THE PSYCHOLOGY OF MENTAL ARRANGEMENT.

By I. MADISON BENTLEY.

Mind is framed on a definite and intelligible plan. Its design is apparent, not to the psychologist, alone, but to any one who is accustomed to reflect on the nature of mental experience. Even if it were possible to overlook the regularity and the uniformity of one's own conscious processes, there would remain, in the orderly arrangement of the objects of knowledge, a sufficient objective guaranty for the orderliness of mind itself. But, although an orderly world implies an orderly consciousness, it must not be assumed, forthwith, that the two orders are identical; that one type of arrangement is common to physical and mental existences. Such an assumption is as premature as is the inference from the nature of physical elements to the nature of mental elements, as set forth in the various 'copy' theories of mind. The actual type of arrangement—within mind, no less than without it—must be determined empirically. Now, the problem of mental arrangement involves such an empirical inquiry into the nature of mental connections. Its solution means the setting forth of all the typical patterns or modes of arrangement into which mental processes fall. This is no depreciation of the worth of analysis. No one can deny that an accurate inventory of things mental is an extremely important part of the psychologist's account of mind; but such an inventory does not properly complete the account. The psychologist must, also, explain just how one mental element fits into another, how part-processes are set into groups and how a well-ordered consciousness differs from a mere collection of sensations, ideas and feelings. Arrangement is no less essential to mind than is the mere existence of elementary structures. And but little reflection is needed to convince one that analysis—no matter how searching and thorough—cannot set forth the entire plan of mind. Even when analysis has reached the last irreducible bits of consciousness, the task of reversing the process still remains. One has yet to discover what has actually been done to consciousness in the process of abstraction and, also, what must be done to consciousness to restore the abstracted elements to the tissue of mind. That is to say, mind must be described in synthetic as well as analytic terms.

Until analysis had been carried to the extreme histological limits which refined methods have made possible, it was customary to solve the problem before us either in terms of association or of intellection; to have recourse either to a "gentle force," as Hume puts it, which brings ideas to mind, one after another, or to an active mental principle which sets in orderly arrangement the materials of sense. But the venue of the case has been changed several times since the days of the associationists and the intellectualists. Instead of seeking to lay a basis for knowledge, by enumerating the likenesses and differences among the objects of ideas, the psychologist sets aside the problem of knowledge and inquires directly into the modes of connection obtaining between mental processes themselves. Furthermore, he pushes the question beyond the train of ideas and seeks to make out the connections among simpler and simpler compounds, until he comes upon the very last terms of analysis and the relations that obtain between these in mental structure. It must also be noticed that this change of procedure has involved a change of emphasis. Attention has been directed from the powers and forces which were formerly thought to furnish the mainspring of mental activity to an empirical analysis of the actual contents of the individual mind. New elements, new arrangements, new modes of combination, have thus been brought to light.

The problem before us is one of the results of the developed analytical method. Given a number of mental elements entering into a group, can one, it asks, regard the group as, in any sense, a bare product or must a unique kind of element, as element furnished by the mind itself, be added as an essential feature of the group? Is the 'fourness' in the perception of four objects or the 'squareness' of the square, itself, an element? It is clear that the question raised is a fundamental one—one that is of vital importance to the psychological system. It is important—I scarcely need to say—because it raises the whole question of the scope and validity of analysis and of the adequacy of the type of description which limits itself to 'elemental' terms. It is the test of analysis by synthesis.

To appreciate all that the issue involves, it will first be necessary to have some notion of what the possibilities of mental arrangement are. In the first place, it is conceivable that a perception or an emotion should be made on an architectural pattern, with sensations for bricks and stones and feelings for mortar. Or the procedure may be supposed to be even simpler than that. It may be like fitting ground and polished stone into ground and polished stone, as in the foundation of a Greek temple;—a simple adhesion so firm and so close that the weight of the race's centuries makes the parts one and obliterates the lines of junction. The architectural figure may, however, be quite wrongly applied. It is possible that mental synthesis is more like the mathematical process of summation, of adding unit to unit; or, perhaps, it is a matter of grinding-up part-processes for the manufacture of new wholes. Again, there may be a communistic participation among mental contents whereby each shares in the product of all; or, finally, mind may stand apart and spin the texture of consciousness from the raw threads of the senses.

Certain of these hypotheses, one is inclined to dismiss at once. But the very fact that the problem can be stated in so many different ways warns us that we must not beg the question at the outset by assuming the truth of any single set of terms. We shall best reach the heart of the problem, even though the procedure be somewhat slow, by tracing back the several arterial channels as they spread themselves through the literature. In fact, the first object of the present paper is to bring together the various recent contributions to the subject. These contributions have been made, for the most part, by the Austrian school of psychologists. In the current English literature, they have not received the attention that their importance seems to warrant. I shall, for this reason, give them as complete a review as my space will permit.

There is, however, one preliminary question in method which must be raised before we begin our historical section. I shall not attempt to answer it now for it will recur presently. It is this: what is the nature of analysis? It will be sufficient, for the present, to recall that there are two general types of analysis. These two types we may, for convenience sake, call the external and internal types. External analysis simplifies a mental complex by simplifying its conditions. If one wants to become acquainted with the elements of a musical note, one may sound, in turn, tuning forks (let us say) corresponding to the several parts or partials of which the note is composed. This is, of course, one of the chief functions of experiment; the simplification of an event through the simplification of its conditioning factors. On the other hand, the same note may be analyzed internally by sounding the note and then turning the attention hither and thither to 'hear out' the partials which make the simple clang. The latter type of analysis may, indeed, first reveal itself in an immediate apprehension of the whole as made up of a plurality of parts (*cf.* Stumpf's definition of analysis). Both kinds of analysis are justified in psychological procedure by their results. The great difference in the results is this: the one tears a member from its fellows, wrenches it from its setting and places it in comparative isolation; the other either subordinates a part to the whole or it clarifies a part—makes it stand out from the whole—but does not destroy its organic connections. The part 'heard out' or 'seen out' or 'tasted out' is always heard or seen or tasted on a background which stands up close against it and, at the same time, sets it in relief.

It is extremely fortunate for psychology that both these methods are at hand. The experimentalist, when he is charged (usually by the sentimentalist) with lacerating mind in his vivisection, has but to turn to his alternative method and justify his account. By examining the members of a complex, now in connection and now out of connection, he comes to see exactly what the connection means and in how far it alters his elements.

We may pass now to the concrete discussions of our specific problem.

The first man to take up the question for its own sake and to treat it systematically was Chr. v. Ehrenfels, now Professor of Philosophy at Prague. Ehrenfels[1] was attracted to the question, first of all, by E. Mach's work on the *Analysis of the Sensations* (1886). Mach had said that when we listen to a melody or look at such an object as a tree, we *sense* the melody or the tree immediately, as a whole; *i. e.*, we have sensations of spatial form and of tonal form.

To understand clearly what Mach means by a sensation of space-form or of melody, it is necessary to recall his peculiar use of the term 'sensation.' "The world," he says (*Analysis of Sensations*, trans., p. 10), "consists only of our sensations;" and again, "we have knowledge *only* of sensations." That is to say, the sensation is not simply a mental process, but a bit of knowledge. It is, moreover, distinguished from intellect by being an *immediate* bit of knowledge; what we see, hear, or handle, and not what is worked out by the understanding. These sensations, Mach analyzes in a twofold way: as mental fact or as physical fact, according to the point of view from which he regards them. Sensations are, then, the elements that make up the world. To search them out, one has only to analyze the world. The sight of a tree involves color-sensations and space-sensations. Color and form can be varied independently; changing the color does not necessitate change in form, and *vice versa*. So with a melody. Though the tonal sensations (pitches) differ, one can still have the same melody (as a tune set in different keys). This melodic form, then, which is independent of absolute pitch, is apprehended immediately and is, therefore, a sensation—a time-sensation, an ultimate element in experience,—one which must, moreover, depend upon a particular system of neural processes.

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[1] *Vierteljahrsschrift für wisse* [illegible] Vol. XIV (1890), p. 249.

This is the point at which Ehrenfels takes up the investigation. What now, he asks, first of all, are these space-forms and time-forms of Mach's? Are they simply combinations of elements or do they introduce something new; something not contained in the elements? Mach, he thinks, is not clear on this point. He proposes to work it out.

Ehrenfels puts the problem in this way: Suppose that there stands in consciousness a group of *n* tones forming a melody, each tone having its definite place in the series; the question arises, 'is there in the apprehension of the melody, anything more than the *n* individual tones taken together?' Or 'is there more in a space form than the *n* determinations of position?' Such a question cannot be decided by simple introspection. It is too subtle and too delicate. One must proceed, therefore, more objectively.

The presumption against a new element rests, says Ehrenfels, upon an unwarranted extension of the concept of conservation. But the principle of conservation does not apply to mind as it applies to matter. The combination of material elements is one thing; the synthesis of mental elements quite another. But if conservation does not stand in the way of new synthetic elements, neither does the principle of psychophysical parallelism. For it may well be just the physical correlate of the individual consciousness that furnishes the substrate for a new element. The very physiological condition (whatever it may be) that makes all the tones of a melody appear in a single individual's experience is sufficient to satisfy the parallelist's objections to a new element.

These theoretical difficulties settled, Ehrenfels proceeds to develop still further Mach's idea of formal elements. He proposes, as a general term, the words 'form quality' (*Gestaltqualität*). The proof for the existence of form qualities or qualities of form lies, as Mach indicated, in the similarity of groups which are made up of entirely different elements. Mach's melodies and spatial figures are good examples. Here is the argument as put forth by Ehrenfels. Complexes which are nothing but sums of elements must be more similar the greater the similarity of their several elements. But a melody in different keys—*i e.*, with all its tones different—is more like itself than it is like another tonal sequence built upon the same elements. And the likeness is apprehended immediately, without reflection (*i. e.* it is Mach's sensation). If one objects that the melody lies

ansition from tone to tone (in different keys),

on' brings in something which is more than a sum. It is just another word for 'tonal form.' And the same is true of spatial forms. Any figure is more than a sum of positions. Ehrenfels defines form qualities, accordingly, as positive ideational contents, appearing in consciousness with such ideational complexes as are composed of separable elements. Any ideational complex which is necessary for the appearance of a form quality is called the *ground* or *basis* (*Grundlage*) of the form quality.

It is not surprising to find that Ehrenfels's broad definition yields a host of combinational qualities. All of these, the author places in one of two general classes. They fall either into the 'non-temporal' or the 'temporal' class, according as their elements are all apprehended in a single perception or require images of memory and expectation. A picture, *e. g.*, which is apprehended at a glance, involves a non-temporal form quality, while a melody or a gradually changing color is grasped as a unitary whole only by the co-operation of perceptual and memorial factors and includes, therefore, a quality of the second class.

Form qualities are, by no means, limited to Mach's tonal and spatial forms. Perception is full of them. First of all, the various determinations of visual and tactual space-perception, including the perception of movement, give a large number. Audition yields, besides the temporal form qualities of melody, the non-temporal qualities of harmony and clang color. To these are to be added color harmonies, fusions of pressure and temperature (as in the perception of liquidity) and of pressure, smell and taste. Moreover, any change in any definite direction, as rise in scale, reddening, cooling, blanching, growing blue, can be apprehended as a unitary and independent thing and, hence, becomes a form quality.

According to the definition, relations come under the same heading. But they differ from the qualities that we have been considering. A melody or a square is not simply a sum of likenesses and differences (comparison-relations). A melody is heard, a square seen, but likeness and difference are not seen and heard. And, in the second place, relations involve an activity of the subject, *i. e.*, *comparing*. This activity consists in shifting the attention from one of the related things to another. It is a change and, like every other change, can form the ground for a temporal form quality.

Similarly, the incompatibility of two mutually exclusive ideas (as of a thing that is both round and square) is an ideational element which forms the basis for the negative judgment —the judgment of incompatibility, contradiction. This is to be considered as another instance of form quality.

Thus far, we have spoken only of form qualities which involve relatively simple groups of elements—perceptions and relations;

groups, we may say, of the first order. Ehrenfels does not, however, stop with these but proceeds to indicate still another class of form-elements; namely, "form qualities of higher order," qualities which are themselves built up out of simpler form qualities.

These structures of higher order arise in two ways; (1) by the comparison of the simple form qualities that we have discussed; *e. g.*, by a comparison of melody with melody or of movement with movement, and (2) by the simple combination of qualities of the first order; *e. g.*, by the union of two or more melodies in a polyphonic composition. Thus we see that form qualities of a higher order are composed, as are those of lower order, by a comparing, 'relating' activity or by a more passive combination of simpler structures.

But this twofold origin of form qualities leads to a difficulty. It introduces the very troublesome concept of mental activity. Ehrenfels takes account of the difficulty by raising the question: in how far does the form quality arise directly from the elements and in how far does it involve a special activity of the intelligence? Mach was explicit on this point. The melody or the space, he said, is just 'there.' It is immediately sensed when the tones or visual qualities are given. There is no question of a special synthetizing activity. Ehrenfels's answer to the question is substantially the same as Mach's. One is, he admits, often conscious of tension, exertion, in apprehending forms and melodies, but this apparent activity in the creation of a form quality is really directed toward collecting the elements into a group. For example, the effort one feels in "taking in" a picture or a melody, as a whole, is expended in bringing together the colors or the tonal elements and not in the construction of the form quality itself. If there were, Ehrenfels argues, a specific activity connected with the form quality, it would surely thrust itself upon attention, since these unique contents play so prominent a part in consciousness. But of such an activity we have no direct knowledge, and the inference is that it does not exist. Even the class of form qualities known as relations involve, only indirectly, mental activity. The "comparing activity" is but the shifting of the focus of attention from one of the related elements (*Fundamente*) to the other. It is concerned, therefore, with bringing together the materials for the form qualities and not with the creation of these qualities themselves. The relation of the "creative activity of the imagination" to form qualities is not so successfully set forth by our author. He seems, however, to intend, even here, that any special activity shall be directed, as before, to the *Grundlage* and not to the new qualities produced; but, unfortunately, he neglects to describe the processes through which this creative activity operates. One may say, further, by way of criticism, that this particular part of Ehrenfels's discussion is of little value because it contains no adequate analysis of the concept of activity. His general results are, however, important for analytic psychology. In a very great variety of mental complexes,[1] over and above the elements into which the complex falls, there remains, he insists, a mental factor which is a necessary and characteristic feature of the complex;—something which may remain unchanged even though all the elements be altered. This new factor, this 'positive ideational content' is the "form quality."

The position which Ehrenfels takes will best be criticised after its other representatives have been considered. One point in his argument may, however, detain us a moment. It concerns his proof for the existence of form qualities. The proof lies, as we have seen, in the possible substitution of elements without change of form, and it rests upon the 'axiomatic' proposition[2] that 'sums are more alike the more alike their elements.' This statement is, as it stands, not entirely free from criticism. The word 'sum' has a strong mathematical connotation; but, as it is used by Ehrenfels, it refers plainly enough to the combination of qualitative units. If the 'axiom' be taken in a purely quantitative way, it will not stand without modification. For two numbers, exactly alike, may be the sums of quite different terms;[3] *e. g.*, $9+8=1+16=17$. That is to say, two like magnitudes may be considered as the sums of very different part-magnitudes. The statement is true, however, so far as it is taken to mean that as much can be got out of a sum as is put into it; so far, *i. e.*, as summating is just piling up like units without regard to qualitative differences. But when the term 'sum' is transferred to qualities, the axiomatic nature of the proposition cited becomes more dubious. Now mathematical formulation becomes inadequate and one is obliged to resort to description. Description becomes necessary, apparently, because qualities can combine in different ways and because the mode of combination is very apt to affect the product. We see this continually in physical science. One and the same element or group of elements has allotropic forms, substances with widely differing characteristics; *e. g.*, graphite and diamond or calcite and aragonite. And, again, organisms composed of the same typical elements present great variability of form and function. We may say, in general, that any structure made up of heterogeneous elements—if it be anything more than a mere collection or heap—implies arrangement, plan, pattern, and not simply addition of abstract units. Mechanical processes, even, furnish illustrations. The sand on the vibrating plate falls into definite figures, sediment is laid into a stratum, the mountain is pushed up into a characteristic shape, the cooled substance falls into a determinate form of crystallization. And should we not expect that, in any formation as complex as a mental formation and in one arising under as complicated and variable conditions as it arises, the characteristics of a group should be determined, not only by the elements cohering, but also by the manner in which these cohere?

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[1] "Gestaltqualitäten enthalten somit die meisten Begriffe, mit denen wir operiren" (page 282).

[2] "Man kann nämlich von vorne herein behaupten, dass verschiedene Complexe von Elementen, wenn sie in sich nichts Anderes darstellen als die Summe derselben, um so ähnlicher sein müssen, je ähnlicher ihre einzelnen Elemente unter einander sind" (page 258).

[3] See A. Höfler, *Psychologie*, Wien und Prag (1897), p. 152.

The combination of qualities must, then, take account of modes of combination and patterns of structure. Such combination cannot properly signify simple addition in a one-dimensional, abstract, number series. Considered thus, Ehrenfels's statement becomes anything but axiomatic. Once we admit that qualitative groups may have properties or attributes or characteristics which are not to be found in the elements grouped, the summating process must either be thrown out of court in any inquiry like the present, where a full description of qualitative components and resultants is required, or it must be modified to suit the facts and thus lose its axiomatic character. It appears equally incorrect to say that, in psychology, $1 + 1 = 2 + x$ or that mental synthesis is a simple process of addition which follows the time-honored traditions of arithmetic. It is no adequate description of the fact to affirm that, when *c* and *g* are sounded together, 1 tone + 1 tone = 2 tones + form quality. The equational form of statement is itself out of place. If psychology had to deal only with groups of simple elements which lie in a one-dimensional series (as 1, 2, 3, . . n) in which no substitution or transposition were possible, the formula of the sum might, perhaps, be applied. But suppose we have such a series as the following: $1, 2, 3, 4, 5, 6, 7, 1', 2', 3', 4', 5', 6', 7', 1'', 2'', 3'', 4'', 5'', 6'', 7''$. . . . . . In this series, a group from the primed section may be more like groups well above and below it than like groups of its immediate neighbors. The matter thus becomes more complicated. And yet this is what we actually do have in the case of melody. We may have the same melody played or sung in different octaves. The point of the matter lies here. Melody is several degrees removed from simple sensational complexes—if by 'sensation' we mean a purely elemental bit of mental furniture. There are a great many things to be known about melody and several theories in regard to its basis which must be reckoned with before we are in a position to decide on the presence or absence of qualities of forms. Melody is a matter of musical practice and of æsthetics. To understand it, one must understand the various phenomena of fusion, of consonance and dissonance, of clang relationship and the canons of musical structure.

I shall not enter into these things. I point them out only to show that one cannot say off-hand: "melody is more than a sum of sensations and, therefore, contains a new conscious quality which we will call a quality of form."

The illustration from spatial form is not much more convincing. It assumes that the spatial sensation-element is a locality-determination—a 'hereness' or a 'thereness,'—and then asserts that a space form is more than these, because the form may remain while these change, *i. e.*, a form is the same form whether in *this* place or *that* place. It may be answered that the particular theory of space that a man holds decides what he shall consider as the spatial element: it may be a locality-determination, or it may be something quite different. Moreover, the general argument against 'summing' qualities applies here as elsewhere.

Still the problem remains, and we shall look for its clarification in simpler and more unambiguous examples. The fact that both Mach and Ehrenfels have in mind is this. We perceive unitary things and not random qualities agglutinated in haphazard fashion. To these unitary objects of perception must correspond some determination in consciousness. What is it? Is it something in the elements or is it something new added when qualities are combined? In short, what is the 'togetherness' of conscious processes? For my own satisfaction, I conceive the problem in terms of some such simple combination as the simultaneous or successive sounding of two simple tones—say *c* and *g*, or the perception of liquidity or a taste fusion. These give us all the necessary data; the unity of the experience and the elements. Moreover, a group as simple as the fusion or the tonal sequence *cg*, contains everything that Ehrenfels's definition demands for the form quality. The interval—the fifth—remains though the elements be changed; a transportation to *da* or *fc* does not destroy the 'fifthness.' Now we have reduced our form quality to its lowest terms. The question arises, is the "positive ideational content," the *Etwas Neues* still present? Shall we say with Stumpf that there is only a characteristic form of grouping, a fusion of a given degree, of a given unitariness, or is it necessary to admit the inadequacy of the tonal elements given through analysis and to add "qualities of form?"

If we have somewhat cleared the ground provisionally, we may proceed to take up the historical thread of the argument where we dropped it. The discussion is next entered by Professor A. Meinong, of Graz, who, for the most part, seconds Ehrenfels's conclusions.[1] Ehrenfels's negative argument (that like elements produce like complexes) is, he thinks, conclusive; but the more positive arguments for the nature of the new factor in the complex must, says Meinong, be carried further. He objects, moreover, to the term 'Gestaltqualität' on the ground that it is ambiguous and inappropriate. He suggests, as a substitute, the phrase, 'funded' or 'consolidated contents' (*fundirte Inhalte*).

The figure is a very forcible one. It is drawn, without doubt, from the terminology of public and private finance. To fund is to bring together accounts, usually floating debts—temporary debts for whose payment there is no special provision—and to issue, in their stead, stocks or bonds, which mature after a term of years; *i. e.*, various liabilities are brought together and put into a common fund. Creditors may be induced to exchange their claims and become either members of the corporation (by taking capital stock) or permanent bondholders of the company. In either event, the scattered claims are brought together and put upon a firm and permanent foundation. The significance of the process is brought out, even better, by the term 'consolidation' which is literally 'a bringing together and making solid.' It means to compress, to pack together, to make more coherent or compact. We have, *e. g.*, in corporate finance, consolidated bonds which are issued by a railroad company against all the lines of a consolidated system, or by a government, in order to bring together, in one single form of stock, various outstanding debts,—as the famous "3-per cent. consols," provided for by Parliament in 1751.

Funded or consolidated contents, are, then, such contents as are produced by bringing together, in a very intimate way, various part-contents. These part-contents, which are merged in the consolidation, are called the funding or consolidating contents (*fundirende Inhalte*) and the new contents produced by the consolidation are the funded or consolidated contents (*fundirte Inhalte*).

Meinong finds the germ of the funding notion in Ehrenfels, who had spoken of the 'fundament,' the 'foundation' (*Grundlage*) upon which a form quality is built up. Meinong carries the notion further by adding to the foundation or the funding basis, the contents which are funded (or founded).

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[1] *Zeitschrift für Psychologie und Physiologie der Sinnesorgane*, Vol. II (1891), 245.

He also suggests that since 'fundament' has a specific meaning in comparison (*i. e.*, it refers to the two things which are brought into relation—as when orange is compared with red), it is better to substitute the word 'members' (*Glieder*) for the wider significance. And since a word is needed to cover all the conscious factors involved in consolidation, he proposes the term 'complexion.' The melody, *e. g.*, is a complexion. It contains both the consolidating contents—the various notes played or sung (the members of the complexion)—and the consolidated contents; *i. e.*, the new factor that emerges when the notes are taken together, the unifying factor in the complexion, the "taken-togetherness" itself, the unity of the new fund that cancels the old debts. Meinong is able, by these modifications (which are really nominal rather than essential modifications of Ehrenfels's doctrine), to bring the complexion into connection with the relation. The relation also implies consolidation; for there is the same sort of a unity formed when one thing is related to another as is to be found in the melody or the spatial form. The relation is a certain kind of a consolidation seen from the inside, so to speak; *i. e.*, you compare A and B (set them into relation) and you get a result—'similarity'—which is not in the members. It is really a funded content. Where you get a relation and where you get a complexion by funding your members, has to be determined. In melody, *e.g.*, or in the musical chord, you do not set each element into relation with other elements (that is to say, you do not compare the parts) but you get a unity, a fusion. The elements flow together into a complexion. In comparing red and yellow, on the other hand, there is more of an exertion of the subject and a (similarity) relation emerges. The *funding* is more or less spontaneous, whereas there is a distinct *act* of comparison.

Meinong has undoubtedly thought the matter out more thoroughly than Ehrenfels. Naturally: Ehrenfels broke ground. We have now, in place of the single term, "form quality," the more analytic terms, "members," "complexion," "funding" and "funded contents."[1]

More recently,[2] Meinong has extended his researches into funded contents and has added several new concepts. He brings both complexions and relations together into a more generic class which he calls *objects of higher order; i. e.*, objects which are intrinsically dependent upon other objects. The relation (*e. g.*, 'difference'), exists only in connection with objects compared; the complexion (*e. g.*, melody) is built upon the members (tones). The object thus founded, *i. e.*, the object of higher order, is called *superius*, the objects upon which it is built—the things related and the members of the complex—are called the *inferiora* of the higher object. Just when the relation and the complexion have been set side by side as co-ordinate classes of objects of higher order, it is something of a shock to learn that a complexion always implies relations and that relations enter into complexions. It is necessary to follow Meinong into his logical tangle only far enough to see that he means that the members of a complex are set into relation and that this relation is vital to the unity of the complexion.[1] The complexion depends upon the relation and the relation upon the constituent members. It is the relation and the members taken together—not as a sum, as $a + b + r$—but objects-taken-in-relation that make up the complexion. When, however, Meinong finds, first, a relation, r', between a and r, then a corresponding relation, r'' between b and r, and relations, again, between these relations, and thus on to infinity, we find the argument unconvincing. Such 'relations' are either psychological fictions or logical abstractions. And, moreover, it must be admitted that the useful term, 'complexion' is indefinitely weakened by an unwarrantable extension of the 'relation' concept. It is to be remarked, also, that the later article is much less significant to us than the earlier one (*Zeitschr.*, II) because it is more epistemological than psychological. It leaves contents (*Inhalte*) for objects (*Gegenstände*).[2]

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[1] Ehrenfels accepts Meinong's new terminology. *Cf. Vierteljahrsschrift für w. Philos.*, XV (1891), 293.

[2] Ueber Gegenstände höherer Ordnung und deren Verhältniss zur inneren Wahrnehmung. A. Meinong. *Zeitschr., etc.*, XXI (1899), 182.

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[1] The writer cannot avoid the suspicion that this much-used term 'relation' is really employed in two different senses by Meinong—even where he does not give notice of a double meaning: (1) in a wider—the more usual—sense (as a relation of similarity) where he seems to understand by it a conscious act which brings about a togetherness-of-contents ("Bewusstsein des Beisammen," XXI, 197), and (2) in the more restricted sense of simple grouping as in a fusion of auditory or visual elements. In the writer's opinion, the two cases are quite different and should always be distinguished. It is a question, as we shall see later, whether this bringing together of conscious contents is itself a conscious process or act or whether it is not—at least in the second case just cited—a logical formulation, substituted for a simple standing-together-in-consciousness.

[2] *Cf. Ueber Annahmen*, von A. Meinong, Leipzig (1902). In this most recent discussion, Meinong explains (p. 8) that his earlier phrase 'funded content' should stand 'funded object' since that which is really produced by funding is an object and not an idea (*Vorstellung*). This changes the case not a little. We may readily grant that it is impossible to dissolve an object into a series of sensational elements. But such a concession does not make it necessary to add a new unifying factor to consciousness. If we take into account the fact that mental processes are not only existences but also symbols which refer beyond themselves, to objects, we see that the existential side of the

There is, however, one special divergence in the two articles that deserves to be noticed. In the earlier account, consolidation or funding covers all ideas (*Vorstellungen*) which are dependent on others; *i. e.*, those which have *Grundlagen*. Every complexion and every relation, apparently, involves both funding and funded contents. In the later article, a distinction is drawn between ideal and real relations and complexions, and only the ideal are said to depend upon funding. Real objects are those that exist in actuality, or that may exist, —as a house, a book, a color, a tone. That which does not and cannot have actual existence (*existiren*), although it *is* (*besteht*), is an ideal object (XXI, 198). 'Deficiency,' 'limit,' 'past,' are instances. The distinction of real and ideal is carried over to relations and complexions. 'Similarity' is an ideal relation, 'fourness' (as in the enumeration of four objects) is an ideal complexion; real relations and complexions, on the other hand, are such as are perceivable (*wahrnehmbar*); as the relation between a color and a spatial locality or the complexion of a tonal fusion. In the real relation and complexion, the perception determines the superius; in the ideal relation and complexion the superius is determined by the process of funding. Thus "funding performs for ideas of ideal objects the same function as perception (*Wahrnehmung*) performs for ideas of real objects" (203). The point of this distinction is, if I do not misinterpret the author's very condensed account (he promises to give a full discussion of the subject), that funding is an operation, an act (apparently, a 'judgment,' p. 201) by which an object (superius) is wrought out, 'produced,' from the inferiora. 'Funded objects' stand over against 'objects of experience' (*Erfahrungsgegenstände*). Both arise immediately; the one through the process of funding, the other through the process of perceiving. Just exactly what the difference is remains, at the end of Meinong's discussion, almost as much of a mystery as ever. It is not clear why funding should, in the later account, apply to a *single class* of objects of higher order (ideal complexions and relations). The criterion "logical necessity" under which the superius is said to be funded out of the inferiora (as the ideal relation, 'difference,' in the comparison of A and B) seems also—against the author's inten-

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object's unitariness may be just the togetherness of the processes as they stand arranged. We should have, then, on the side of consciousness, merely the plan of arrangement of processes and, on the side of the object, the functional aspect of this plan or pattern; namely, the unitariness, the wholeness, of the object perceived. At all events, we must keep distinct the psychological and the epistemological problems of perception. Then we shall see that the establishment of a cognitive 'fund' need not imply a corresponding 'fund' among sensational elements.

tion—to cover cases of real relations and the "objects of experience" which are based upon them; *e. g.*, an interval in tonal fusion (one of Meinong's instances of a 'real relation') follows as inevitably from the nature of the tonal elements involved as the judgment 'different' from the comparison of red and green. If funding is dependent upon "logical necessity" in the emergence of the superius, why, then, is not the fusion as truly funded as the (ideal) difference-relation?[1] In the case of melody Meinong does admit this 'logical necessity' that makes the melody a funded complexion. But how the melody can be unequivocally determined by the elements (tones) and the fusion not, it is difficult to see.

Some additional light is thrown upon the subject of consolidated contents by H. Cornelius (Privatdocent in Munich). Cornelius,[2] instead of starting from simple contents and asking what occurs when these are brought together, starts with the complex, which he calls the fusion. He affirms that the primary mental structure is a whole which is only gradually broken up into parts by the analyzing process of attention. What do we see in a thing, Cornelius asks, before we come to know it intimately? Why, he answers, a big, unanalyzed, undissected mass (*Gesammteindruck*). Just a whole. Precisely as the unmusical individual hears a chord without analyzing it or as most of us hear the clang color of a musical note or perceive a face. By attending, now to this part of the mass and now to that, we are led to the inference that the mass is really complex, made up of parts. If this critical scrutiny be repeated often enough, the mass finally falls to pieces without an effort; *i. e.*, we analyze 'on sight' and spontaneously. And when we do—and this is the important point—something disappears, is lost. Analyze your note and clang color disappears; play your melody slowly enough to make it fall to pieces and only a detached series of notes is left. This change, says Cornelius, is an actual loss in contents. Thus he comes to the same conclusion in regard to the existence of a unique factor in the complex, or the complexion, as Ehrenfels and Meinong who worked up from below instead of working down from above.

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[1] Just as this article was ready for the press the important monograph "Ueber Annahmen" came to the writer's hand. The monograph gives a systematic setting to the phenomena of funding, of complexions and of objects of higher order. Unfortunately, no adequate account can be taken of it here. It seems, however, to represent the same position in regard to the concepts with which we are dealing as the *Zeitschrift* article (XXI) to which we have made frequent reference. "Logical necessity" is again given as the criterion of consolidation. "Fundirte Gegenstände sind mit ihren Fundamenten durch Nothwendigkeit verknüpft" (p. 12).

[2] *Vierteljahrsschrift für w. Philos.*, XVI (1892), 404, and XVII (1893), 30.

If we grant Cornelius's presupposition, then, we get additional evidence for qualities of form (Ehrenfels) or consolidated contents (Meinong). For if some 'positive conscious content' is lost in analysis, it is quite possible that this is no other than the funded content which characterizes Meinong's complexion. Funded content means, however, for Cornelius, the 'sensation-whole,' the unanalyzed fusion and not, as for Ehrenfels, something added to the sum of the parts. It is to be noted, moreover, in passing, that, although Cornelius and Meinong both contend for the existence of funded contents, their theories of analysis are radically different. Meinong (who is happiest when he is standing sponsor for a concept) develops an elaborate terminology and technique to explain the process of analysis.[1] It should be remarked that it makes little difference to our main problem whether the fused undifferentiated whole (*Gesammtvorstellung*) or the analyzed complex were the original type of mental formation. Our primary question is a question of content and not of origin.

One further point only is it necessary to mention. Although analysis, the breaking up of a whole, does not create the sensational elements, it may, nevertheless, says Meinong, alter the funded contents. In the clang, *cg*, for example, one gets different funded contents and, therefore, different complexions according as one attends to *c*, or to *g*, or to *cg*. To state the matter in general terms, the process of funding and the character of the complex depend not only on the quality and the intensity of the funding contents (the inferiora) but also upon the direction of the attention. It is to be noted that both Meinong and Cornelius go a step beyond Ehrenfels in this particular. For Ehrenfels, the funded contents are maintained so long as the relation of the parts is maintained. Transposition, *e. g.*, does not destroy the funded melody. For Meinong and Cornelius, on the contrary, the funded contents can be altered, even without change of elements, by a shift of the attention. For the later writers, then, funding is a more subjective process, more independent of external conditions, than it is for Ehrenfels.

An addition to our systematic knowledge of complexions is made by Stephen Witasek (a pupil of Meinong at Graz). Witasek[2] works out Ehrenfels's instances of *Gestaltqualitäten* which are themselves based upon other *Gestaltqualitäten; e. g.*, a polyphonic composition made up of different 'voices,' each of which is itself a complexion. These complexions, which are twice removed from simple unfunded elements, or members, he calls "complexions of higher order." (This term is to be kept distinct from Meinong's "objects of higher order" which embrace the objects of *all* complexions and relations).

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[1] For Meinong's views of the function of analysis see *Zeitschr., etc.*, VI, 340 and 417. Cornelius's account of fusion and analysis should be read in connection with Stumpf's *Tonpsychologie*, Vol. II.

[2] *Zeitschr., etc.*, XIV, 401.

The most important part of Witasek's article deals with the formation of complexions. Some complexions, he says, are made quite automatically. The partials in the note combine (are funded) in a perfectly unequivocal and effortless way, producing the clang with its characteristic color. The case is similar with the melody. The funding does itself, so to speak. But in the case of complexions of higher order, the possibilities for funding are increased. In a contrapuntal arrangement, *e. g.*, one might find each voice funding by itself and then uniting with other voices as a complexion of higher order, or the primary complexions might be harmonic complexions between the simultaneous parts of the several voices, or, again, the funding might proceed quite irregularly by combining successive notes from different voices. These and still other possibilities arise where complexions of higher order are involved.

The complexion that actually does issue from all these possibilities is decided by many things. The first prerequisite is that a group of elements should be disentangled from the mass. This is often accomplished externally; *e. g.*, the solo voice is more intensive than the accompaniment. Then, too, it has its own distinctive clang color to set it off from the other sounds and to hold it together. And, finally, spatial position and pitch may also contribute. But beyond these external conditions, Witasek sees a special activity of the subject working upon the members, when they do not, of their own accord, fall into definite complexes.

At this point there is a dissenting voice raised on the subject of funded contents. F. Schumann (Stumpf's assistant in Berlin) takes the field against the champions of consolidation.[1] Schumann gets his bearings from unpublished lecture notes of G. E. Müller's. Müller had said that we apply various predicates to both simple and complex mental contents by noting the similarity of these contents to others and by placing them in various groups.[2] A simple tone, *c*, falls into an intensity group, a quality group (the one-dimensional scale of pitches), and a clang color group. In a similar way, mental *complexes* evince similarities and fall into groups. In the second case, no more than in the first, is there a special relating activity, a higher mental faculty involved. This statement seems, to Schumann, to stand directly against the contention for a new kind of relating activity which is involved in the theory of funded contents.[1] Having taken his general position, Schumann proceeds to criticise more circumstantially. Ehrenfels's negative proof has, he thinks, some weight; but the inference to the 'positive ideational contents' is unwarranted. Melody is a poor illustration because it has not yet been sufficiently factored for us to tell what it contains[2] and the "determinations of position" (*Ortsbestimmungen*), the elements out of which spatial figure is said to be funded, are fictitious elements from which no conclusions such as Ehrenfels's can be drawn. Moreover, Stumpf has disposed of clang color (as Meinong himself admits) by referring it back to a 'tonal color' in the elements and temporal unities may be shown to be bare sensational stuff. The unitariness, the wholeness of complexes, upon which so much stress has been laid, is, first of all, for Schumann, a unitariness in the sense that the complex *functionates as a whole* in influencing reproduction, judgment and feeling. Schumann is of the opinion that the 'funded' part of the complexion may be resolved into feelings and accompanying ideas.

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[1] *Zeitschr.*, *etc.*, XVII, 106.

[2] Essentially the same as Hume's argument on the *distinctio rationis*, *V Treatise*, Bk. I, part 1, sec. vii.

This destructive criticism is couched in too general terms and is too little thought out to be entirely convincing, but it is, nevertheless, vigorous and pointed. Meinong replies[1] at length taking up Schumann's points in great detail and reaffirming his old position taken several years previously.[2] Cornelius,[3] on the other hand, thinks that he sees a chance to reconcile Müller's view (which he himself has sustained in his *Psychology*[4]) with the doctrine of Ehrenfels and Meinong. Just as quality and intensity and extent are attributes or modifications of the sensation, so, he maintains, are form qualities and funded contents attributes or modifications of complexes. And they are brought out in the same way; namely, by noting the resemblance of the sensation or of the complex to other sensations or other complexes; by putting it in a group. It is, therefore, not correct to speak of the modification or attribute (*Merkmal*) of a complex as a new content which depends upon the juxtaposition of elements, unless one means by 'content' *abstract* content; that is to say, one got by abstracting a single aspect, as the 'fifthness' of the fifth or the 'thirdness' of the third. There is, Cornelius continues, no reason why the similarities of complexes should depend upon the similarity of their parts. They may be functions of the complexes as wholes. The form quality is not, then, as Ehrenfels and Meinong say, a new positive content (*Inhalt*) but an attribute, a characteristic, a property (*Merkmal*).[5] We shall, then, have to speak of 'fundirte Merkmale' instead of 'fundirte Inhalte.' Considered thus, form quality is just a name for the similarity of complexes, but is not an explanation. It is a matter of direct experience.

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[1] Precisely how the champions of consolidated contents conceive the 'activity' to which Schumann objects, it is not always easy to decide. Ehrenfels denies, as we have seen, any special activity. Meinong disagrees with Ehrenfels's argument that the form quality is given invariably with the elements (*op. cit.*, II, 260). Elements are funded only under quite definite conditions. There must be an act of the subject; and, in comparison, Meinong maintains, "the subject must contribute considerably more than in the perception of form or melody and yet, even here, not all is left to the funding contents." In another place (XXI, 201), Meinong says that the superius, 'difference' (as in comparing A and B), demands not only an act of judgment (and "Alles Urtheilen ist ein Thun"), but also a working over of the materials with which the judgment has to operate. Again (XXI, 204), funding is spoken of as a 'process' (*Fundirungsvorgang*), which may be ushered in by what are called the "higher intellectual operations." Still again, funding is called a "producirende Thätigkeit" (*Ueber Annahmen*, page 9). Witasek goes still further and declares for a synthetizing activity by means of which the will exerts an influence on the formation of complexions of higher order. "Der fundierte Inhalt ist nicht lediglich Resultat eines blind wirkenden psychischen Mechanismus, sondern wir selbst fassen nach eigenem Ermessen die einzelnen Bestandstücke zu diesen oder jenen Gruppen zusammen und bedingen so die Form der zu bildenden Komplexion höherer Ordnung." (*Zeitschrift, etc.*, XIV, 426.)

[2] This objection differs from the one urged above (p. 277). Schumann pleads general ignorance of melodic form. My own contention was that the theory of formal elements does not take account of what is actually known about melody. It presupposes that melody is just tonal sensations or these *plus* a form quality. Meinong's reply to Schumann (XXI, 222) does not touch this point.

Cornelius still leaves unanswered the question, 'how do these new similarities between complexes arise?' He does this purposely, because he is writing what purports to be a purely descriptive psychology; a plain account of conscious events. Professor Lipps, on the other hand, who believes in an explanatory, as well as a descriptive, account of mind, insists[6] that the form quality rests on unconscious psychical processes. In the connections obtaining between mental contents we see only a product. The real causal factors that produce the contents and the connections between them lie behind the scenes, inaccessible to experience.

This view of funded contents, is, one may easily say, as strong or as weak as the general Lippsian doctrine of unconscious psychical processes.

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[1] *Zeitschr., etc.*, XXI (1899), 205.

[2] *Ibid.*, II (1891), 245.

[3] *Ibid.*, XXII (1899), 101, and XXIV (1900), 117.

[4] *Psychologie als Erfahrungswissenschaft*, Leipzig (1897).

[5] For a criticism of Cornelius's Theory of Abstraction, see Meinong, *Zeitschr., etc.*, XXIV (1900), 34.

[6] *Ibid.*, XXII (1900), 383.

With the admission of the funded content as an attribute or a characteristic, we begin to see the end of this long and involved discussion. F. Schumann writes again,[1] giving a large number of significant instances from the domain of visual perception and accepting Cornelius's view of the funded factor as an attribute (*Merkmal*) which rests upon a peculiar and close consolidation of elements in a complex. He shows that in spatial figures there is a greater or lesser unification of the parts which corresponds closely to the fusion degrees of tones;[2] *i. e.*, an approximation of a complex to a single impression. The unitariness is an attribute of the complex which makes it possible to judge the likeness and difference of complexes as such. *E.g.*, the essential characteristic of the square is the like value of the sides (as against the oblong whose two long sides are characteristic) and the rectangularity of the corners. We do not stop to figure these characteristics out, but they strike us at once; they are an immediate "sensuous moment" (*cf.* Mach's term, "space sensation").

G. F. Stout has given in his *Analytic Psychology* (1896) some account of form qualities and funded contents. Stout's position is essentially the same as Ehrenfels's and Meinong's; though his theory of analysis, as a process which works a fundamental change in mental contents, or 'presentations,' is much like that of Cornelius. For Ehrenfels's 'Gestaltqualität,' Stout substitutes the phrase 'form' or 'plan of combination.' He uses the old arguments to show that the apprehension of form is a "constituent of consciousness comparable . . with the perception of red or blue" (Vol. I, p. 66). It is not, then, simply a mode of mental combination, but a distinct kind of consciousness.

It is time now to ask, 'what is the real outcome of all this discussion over form qualities, complexions, and objects of higher order?' Psychology has certainly gained from the long decade of debate. If the whole mass of literature, which we have only just glanced at, did nothing more than fill, even temporarily, a gap in the psychological system, it would serve an portant purpose. But it does more. It shows, in the first ace, how misleading is such a rubrication as 'sense' and tellect.' Mind is not so simple as that one can say of a

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eitschr., etc., XXIII (1900), 1.

he fusion is not, to speak strictly, a characteristic, or *Merkmal*, fusion we mean fused contents. It is only the 'fifthness' or dness' or 'octaveness' which would be considered the new characteristic of the fused complex.

mental formation, 'this is either a sensation that has found its way into mind or a sheer spiritual creation that mind has evolved.' We must reject this unfortunate dichotomy and ask quite concretely the question that we raised at first; namely, "what is the actual plan of mind?" And it is not difficult to see that the investigators whom we have been reviewing have begun at the right end of the problem. They have, *i. e.*, taken comparatively simple instances that do not fall wholly either under 'sense' or under 'intellect,' but which stand on the dividing line. The first point raised was this: are these simple perceptual groupings just sensations (Mach) or are they something more? The writers who contended that they were 'something more' have been concerned to show precisely what the new factor is and what relation it bears both to 'sense' and to 'intellect.'

In the second place, the discussion has shown that a complete descriptive account of a mental complex demands more than an enumeration of its constituent elements taken as isolated units. The complex does not 'feel' as a sum of such elements would feel. This is true whether the 'funding' concept be valuable or worthless.

And, finally, the problems which have been raised in the literature give psychology a good opportunity to test the validity and the adequacy of its mental structures. If its elements prove inadequate when one comes to synthesis, they must either be augmented or their claim to represent the whole of mental tissue must be recalled.

But, even though it be granted that the discussions referred to have borne fruit, we must admit that the specific problems raised have not all been satisfactorily solved. There are, in the writer's opinion, two general criticisms of the results that remain to be made. (1) Where a new 'funded' factor has been found necessary, the true nature of psychological elements has not, as a rule, been kept in view. (2) The concept of 'activity' in the process of funding has not been made clear and unambiguous.

Unfortunately, a specific justification of these criticisms and a positive contribution to the subject would call for a separate article. It may not be impossible, however, to indicate, in a few words, the direction which, it seems to me, promises quickest approach to a solution.

The two concepts to conjure with are the concepts of analysis and attention. It is useless to attempt to decide on the existence of funding contents or funded objects until an agreement is reached on the quale and the functions of analysis; and it is, likewise, futile to dispute over the mental activities involved in funding until the possibilities of attention have been exploited.

What I may have to say on these two topics will, perhaps, be more intelligible if I state, first of all, my own conviction on the general question involved. The hypothesis of distinctive and unique conscious structures which characterize mental complexes is to be entertained with caution, if not with suspicion. Their intemperate use in certain of the treatises that we have discussed is both unnecessary and indefensible. I prefer to say that the essential nature of a complex is determined, not by a funded or formal factor, but by the character of the elements themselves, the connections into which they fall and the state of attention in which the complex is given.

The theory of funded elements derives its chief plausibility from an inadequate definition of element. Reference to our two types of analysis (p. 271 above) will make this clear. External analysis, which fixes attention on stimulus and, particularly, on the progressive simplification of stimulus, is certain to yield abstract, artificial, isolated and self-centered units—as 'red' 'strain,' the tone '*c*' 'pressure,' 'sweet,' 'pleasantness,' etc. Such elements as these are always oblivious to every existence but their own.[1] Each quality is self-contained, sufficient unto itself. This view of elements finds, it is true, ample justification. It is a wonderfully serviceable view in mental analytics. But the point is that the view *is essentially* analytic. If we want to know what mind is like in the concrete, we must supplement the type of analysis by the second, internal, type. That is to say, we must explore all sides of a complex, *as a complex; e. g.*, the visual colligation or the auditory fusion or the melodic sequence. We must search out, in turn, the constituent parts of the complex, while the unanalyzed or half-analyzed remainder is maintained in the background. By this procedure, only, do we get at mental elements as they stand in connection, as they make up the actual living tissue of mind.[2] The element then becomes a simple thing, but a thing with its connections upon it, with its real 'local signature' in the anatomy of mind. But if the element is a being with a *status*, with a place to fill in one group or another, what more is needed to make up the group than just these elements and the plan of arrangement, which is nothing but the elements taken together? Does not the 'funded content' become superfluous? Nevertheless, two things remain to be said by way of adding plausibility to the position. (1) The peculiar unity of the complexion (Meinong) may serve as an argument for a 'plan of arrangement' as well as for a funding process. This unity —whether it take the form of 'fifthness,' or 'octaveness,' or 'squareness,' or 'rectangularity,' or 'violinness,' or 'trumpetness'—need not be the result of a 'unification' content, apart from the ordinary visual or auditory elements. These things are simply the mode, the pattern, in which the elements (as revealed in internal analysis) are set forth. They represent group-characteristics for which, to be sure, we shall look in vain in the abstracted elements of external analysis. Nevertheless, they call for no special conscious moment foreign to the constituent members themselves.

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[1] It is, apparently, this kind of a mental element that James rejects with so much fervor in his chapter on The Mind Stuff Theory (*Psychology*, I, ch. VI). In his impatience at associationists, James overdoes himself in asserting that we cannot "mix feelings as such." He is even led to the absurd statement that the taste of lemonade does not include the qualities acid and sweet (p. 158).

[2] *Cf.* C. Stumpf (*Tonpsychologie*, II, p. 279): "Als Teilerscheinungen im weitesten Sinne können wir schliesslich nicht blos die in einer Vorstellung enthalten absoluten Elemente (die einzelnen Töne, Linien) bezeichnen, sondern auch die zwischen zwei solchen Elementen stattfindenden Beziehungen."

In the second place (2), no account of the psychology of complexes—even of the simplest complexes—can be completed without reference to attention. The skeptical reader may have anticipated the argument at this point by saying that here at last the *Etwas Neues*, the *deus ex machina*, must reveal itself. But, surely, this depends entirely on what one means by attention. Of course, if attention is a particular process among other processes, appeal to such a factor will not remove the difficulty which we are trying to avoid. But, if attention be conceived as a *state* or *condition* of consciousness, with well-marked characteristics and perfectly definite consequences, it may well be that it is the one moment that is lacking to our explanation. It will be such a moment only on condition that the attentive consciousness is a synthetizing consciousness, only on condition that the formation of mental complexes is one of the functions of the attentive consciousness. This is not easy to prove—although it is accepted by many psychologists. A demonstration of the point really requires a theory of attention. It would be foolish to attempt even the outline of such a theory at this late point in the argument. There are, however, two sets of facts which may be set down as favoring a synthetic function of attention. In the first place, introspection bears witness to the fact that objects present themselves as wholes while we attend. *Because* we analyze under attention is no proof that we do not, at the same time, synthetize. Experience, it is true, comes in 'lumps' to the inattentive consciousness. But these lumps are not the unitary objects of perception that stand before consciousness when its parts have been not only brought into focus but also brought together in definite arrangement. Our second argument falls to us from genetic psychology. One of the principal functions of the nervous system is to collect and to co-ordinate the experiences of the organism. It brings together the various aspects of a situation and reflects them in consciousness. It is easy to see that attention to a 'situation' rather than to a disconnected set of sensations and feelings is the more favorable to the organism. Hence we may well suppose that one of the results of natural selection has been to sanction the tendency to attend widely and to group comprehensively the elements of an experience.

At the same time, this argument from genesis proves to be more than an argument for a synthetizing attention. It also confirms our general remarks about plans of arrangement, for it shows us that the simpler mental groups, at least, have been made at the behest of nature. They correspond to situations which have appeared over and over again in the history of the individual and of the race. We can pick out hundreds of spatial and temporal and qualitative groupings which have got themselves formed by persistent and united appeal to the organism; tactual perceptions, smell and taste complexes, auditory fusions, perceptions of bodily position. It is, then, rather the finger print of nature that we trace, first of all, in the 'complexion,' than the operation of a unique mental factor.

The arguments from attention are, I admit, inconclusive. My reasons for bringing them forward are simply these. I have emphasized the concept of attention because it is one of the corner-stones of every modern psychological system; because it has been thoroughly analyzed, and because it is, without any doubt, closely connected with the phenomena which we have been discussing. Every descriptive account of mind involves the attention; from Herbart down, the concept has been exposed to a searching criticism—we know, now, its characteristics, its concomitants and its effects;—and, finally, it lies at the basis of perception and of thought. Why not, then, use it, alongside the concept of analysis, in preference to any ambiguous and misleading 'productive activity' or 'interference by the subject,' or *psychisches Zuthun* or 'newly created content,' in analysis of the complexion?

I may say, however, that in spite of divergence of opinion, Meinong's concept of 'complexion' has, to my mind, much to recommend it. It is an improvement on Ehrenfels's 'form quality' because it emphasizes the organization of elements rather than the *mere* addition of a new quality. Meinong does not, however, move far enough in the direction of organization. His notion of funding or consolidation is, after all, hardly in accord with the facts. These terms suggest too strongly the obliteration of the elements at the expense of the funded contents. To speak strictly, funding, in the literal sense, is only the extreme limit of the process of unification—a limit seldom, if ever, reached in experience.

I should suggest in place of 'funding' and 'complexion' the terms 'incorporate' and 'incorporation.' 'Incorporation' has the advantage of covering all grades of dependence and independence of the parts; and, at the same time, it suggests intimate union, close organization. Furthermore, instead of implying a new conscious structure, it emphasizes the characteristics and functions of the incorporated mass, taken as a whole.

It is only fair to say in closing that the various terms that have been proposed in connection with the present discussion really cover a heterogeneous mass of psychological material which stands in sore need of classification. There can be no doubt that the simple fusion of tones and the judgment of similarity between objects—to take extreme cases—involve very different mental processes. The clearing up of these differences and the systematic envisagement of the general question are, at present, perhaps, the greatest desiderata in the problem of mental arrangement.

THE MOON IN CHILDHOOD AND FOLKLORE.

By J. W. SLAUGHTER, Hon. Fellow in Clark University.

I. INTRODUCTORY.

The safest way to gain a foothold for a study of this kind is to outline at the beginning its purpose and bearings. That its scientific value depends on very definite limitations is obvious to any one familiar, even in small degree, with the subject matter dealt with. The psychologist has heretofore necessarily limited himself to a study of the simplest kinds of mental activity, and excluded everything that seemed too complex for his methods. This led to the relative neglect of a group of processes which have lately been brought into much greater prominence by the genetic method, namely, the instincts and instinct-feelings. Whatever may be meant by these terms, and their connotation is as yet very indefinite, we may at least take them as meaning a series of definite functional relations to the organism's environment. No one, in the present state of inquiry, can seriously doubt that these elements, having behind them all the accumulated force of the evolutionary series, are the chief determining factors in individual and racial life. While the complex organization of human mental life precludes the possibility of tracing the instincts with the same degree of definiteness as in the animal series, yet they mark out with no less certainty the broader areas of human activities. The fact remains, however, that genetic psychology finds it necessary to take a long leap in passing from the animal to the human. The psychological "missing link" is not one but many. In order to supply these lacunæ in the line of development, a new branch of inquiry has been inaugurated and prosecuted with remarkable success, namely, the study of the child in all the stages of growth. But results here must suffer from the obvious limitation that the child's development is only a condensed index of what took place on the larger plane of race history. The steps are passed over too rapidly, and the necessary social environment is too deficient or too false to the child's nature, for the characteristic psychical states to take on definite form. Better cor ons are obtained if the results of this work are conn ctly with the accessible data in the field of race-hi
derived from two sourc

the study of civilized races in their stages of formation. The second of these sources while less accessible is by far the more prolific in materials and interest. The reason it has been relatively disregarded is probably the unsettled state of the science of mythology.

Not many years since, and to some extent up to the present time, it was customary to regard a race's mythology as a curious collection of fantastic fables. Greek deities were studied because Greek sculptors had chosen them for their models, and their legends were investigated because they entered to so great an extent into classical drama and tragedy. Our eyes are just now being opened to the fact that each of these stories is a vast repository of psychological material, representing in crystallized form the accumulated experience of a long process of development. Psychological insight adds immense significance to the Greek and Teutonic epics. Very little is added to the Homeric story when Schliemann tells us that there was a fortified town on the Asiatic coast which the Greeks besieged and conquered. In this mixture of Dichtung and Wahrheit, the former only is worthy of study. It is in the figures of the heroes, the character of Achilles, the treatment of man by man, the games at the funeral of Patroklos, the actions of Helen and Clytemnestra, and above all the circle of divinities in the Olympic council, that scientific, as well as æsthetic interest must center. When we reflect, again, that our own religion and civilization are but further elaborations of myths and legends already outlined in the Vedas, the Homeric epics and the Norse mythology, we are in position to estimate the value of psychological investigation in this field.

While the linguistic school of comparative mythology can hardly expect the assent of the psychologist to all its claims, yet it has made one contribution which must be the starting point of all investigators, the fact that the chief mythological personages are ultimately representations of natural objects and natural phenomena. This connects on the one hand with the biological law of adaptation to the physical environment, and on the other, with the most primitive stages of reflection. We are justified to a certain extent in believing that these early accounts represent what nature actually meant to the most primitive human beings, and their instinctive reactions to it. It is interesting to compare the rigid physical nature of science with the animistic and highly personified environment to which early man actually adapted himself. Out of the feelings and actions which were thought to belong to the ever present and [illegible] f the physical world grew stories and romances [illegible] groundwork of mythology. This point is [illegible] d. The great similarity of the myth-forming process in different parts of the world, and the fact that it is repeated in the life of every child, point to a psychological solidarity of the race which must have deep-lying roots in the evolutionary series. These early legends, as Max Müller says, "though they may be pronounced childish and tedious by some critics, seem to me to glitter with the brightest dew of nature's own poetry, and to contain those very touches that make us feel akin, not only with Homer or Shakespeare, but even with Lapps, and Finns, and Kaffirs."

With this universal animistic view of nature as a background, it seems natural that a great mythological and legendary accumulation should appear in connection with the moon. The following from Harley is an excellent statement of the case: "The sun, incomparable in splendor, invariable in aspect and motion, to the unaided eye immaculate in surface, too dazzling to permit prolonged observation, and shining in the daytime, when the mind was occupied with the duties of pastoral, agricultural or commercial life, was to the ancient simply an object of wonder as a glory, and of worship as a god. The moon, on the contrary, whose mildness of luster enticed attention, whose phases were an embodiment of change, whose strange spots seemed shadowy pictures of things and beings terrestrial, whose appearance amid the darkness of the night was so welcome, and who came to men susceptible, from the influences of quiet and gloom, of superstitious imaginings, from the very beginning grew into a familiar spirit of kindred form with their own, and though regarded as the subordinate and wife of the sun, was reverenced as the superior and husband of the earth. With the transmission of this myth began its transmutation. From the moon being a man it became a man's abode: with some it was the world whence human spirits came; with others it was the final home whither human spirits returned. Then it grew into a penal colony, to which egregious offenders were transported; or prison cage in which, behind bars of light, miserable sinners were to be exposed to all eternity, as a warning to the excellent of earth."

In the present study, ontogenetic and phylogenetic results are placed side by side, but the attempt is made to avoid the mistake of trying to find cases of exact correspondence. Whatever the doctrine of recapitulation may mean when applied to the later stages of growth, consideration must be shown for the immense difference between the two scales. It could hardly be supposed that the later and more plastic formations would appear with the definiteness of rudimentary organs, or that they would necessarily be fixed at all. The well known swimming movements, for example, or those of climbing, are really not rudimentary, as they have no residue, but are a stage in the formation of more elaborate movements, to which they are subsumed. It is thought better, therefore, to illustrate a particular stage or tendency in both the ontogenetic and the phylogenetic series by assembling a large number of expressions on each side, and thus showing a general identity rather than in particulars. It may be argued that it is impossible to get the spontaneous expressions of children on account of the prevalence of nursery and folklore stories. This is true, but the argument hardly seems valid when we reflect that there must be a reason for the existence of all nursery stories, and that the interest which receives is identical with the interest which creates. A child's capacity is not a hole that can be filled with anything, but an active, selective interest. In some cases the external influence is, unfortunately, too great, as, for example, in the idea that the moon is composed of cheese. But on the whole, there can be no doubt that in the material presented there is a wide play of spontaneity.

The children's expressions are gathered from returns aggregating 423, of which 321 are from females, 102 from males. This material was collected by Dr. G. Stanley Hall. The Rev. Timothy Harley's *Moon Lore* made the task of collection much lighter on the side of folklore and mythology.

2. SUBSTANCE, DISTANCE, ETC.

Careful inquiry and reminiscence concerning the substance of the moon show that eighteen children, averaging five years, thought it made of cheese. Sometimes the mice eat it horse-shoe shaped, or that it could be fed by throwing cheese up so clouds could catch it; or it was green because the man in the moon fed on green grass; its spots were mould; it was really green but looked yellow, because wrapped in yellow cheese cloth; it was cheese mixed with wax or with melted lava, which might be edible; there were many rats, mice and skippers there; it grew big from a starry speck of light by eating cheese. It is made of rags, 3; or the man in it is stuffed with them; it is a picture with yellow paint, 4; made of yellow paper, 3; putty, 1; gold, 7; silver, 3; honey, 3; cotton, 3; a lucky stone, 1; a cake of ice, 5; of many stars, 3; air, 1; gas, 2; brass, 4; a plate, 3; a balloon, 3; clouds, 8; a ball, 2; tallow, 2; a lamp, candle or gas, 10; of light, 4; of dirt, 3; water, 3; cloth, 2; a bundle of sticks on fire, 1; milk, 1; butter, 2; felt, 1; lightning, 3; made of dead people who join hands in a circle of light, 1; some bright dish hung up, water and dirt like the earth, 1; a dead skull, 1; a water pail, 2; it is God, Christ, or any one else, 8; is the face or head of some dead relative or friend, 5; stuck out through the clouds, or the body goes straight toward the sky and is hidden from us by the head.

The majority under 8 did not know what it was made of, or else gave answers obviously invented *ad hoc*.

It is as big as a cent, my fist, a football, mamma's face, a jack-o-lanthorn, a dinner plate, a flour barrel, a washbowl, a closet, a mill-wheel, a washtub, a hat, a well, a sewer hole, a house, etc. From forty-four such comparisons, I roughly average that its disk seems at least a foot in diameter.

Its distance from the spectator thought to be 12 feet, as far up as you could reach on a step-ladder, a ladder could be set up against it. In twenty-three cases, children want it given them. It could be reached by going to the horizon, climbing a hill or a tree. Six children ran away to get it as it was rising. Surprise is recorded on reaching a hill-top to find it just as far away. Eight wanted to go to the edge, touch or look close at it to see what it really was. When children are eight or ten, they realize that it would take days, weeks or months to walk to it, and a little later they begin to estimate its distance by absurdly extravagant figures or illustrations. Very common is the idea that there is somewhere a ladder, perhaps of strings, that leads to it.

How it got there and stays is one of the most baffling problems of childhood. It flew up, was blown up, swam up, crept, walked, rolled up, was fastened up in many ways by God or Christ, or some one climbed up to the sky, it glided up just as it now moves, it sailed up from the water, it was thrown up and hung or struck, went up in a power or balloon, was born, made or grew there. Younger children think papa or some adult put it there, or it went up by its own voluntary motion, and only older children think it got up by electricity. The age in which most opinions are expressed is nine, coinciding thus with the age of greatest interest in the puzzle as to how the man got in the moon.[1]

M., 4. Concluded it must be hooked on a board, and his playmates said it was mucilage and strings, because God would get tired holding it.

M., 7. Said the Tower of Babel and the pyramids was to put it up on.

F., 8. Thought it was slid up on the rainbow, and once thought the clouds held it.

M., 9. It was put up by the first men who were very tall and stood on each other's shoulders.

F., 10. Worried her mother with questioning how it could stay up there so long and not fall, as a kite or bird could not stay up.

F., 17. Used to wonder by the hour how it could possibly ever be put up so high, and thought out many mechanical devices.

F., 21. Never noticed much about the moon except sometimes it came around as you sometimes see a cloud or a bird. She never thought of its quarters or whether it moved.

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[1] See Miriam V. Levy, How the Man Got in the Moon, 555 opinions, *Pedagogical Seminary*, Vol. III, p. 317.

M., 18. Used to sit and watch the moon to see if he could see it move, and concluded it must jerk along when he was not looking.

F., 23. Once had a panic on finding that the moon ran along just as fast as she did. It kept just opposite her, and she ran home without daring to look behind.

F., 21. Thought the moon was running a race to get home first.

F., 18. Once on a journey seeing the moon in a new direction, thought they had gone around the other side of it, but finally concluded that it was a different moon from that they had left at home.

M., 11. Said it went with us at night to keep off the dark. Twelve children, averaging eight years old, deny positively that it moves at all. It is always overhead and is fastened, or it may move around a little if it got loose, or it would hit the stars, clouds, houses or trees if it moved. Very many looked for feet or wings, said it rolled like a hoop, or slid, pushing everything before it.

M., 8. Sometimes it comes out of the woods, sometimes out of the river, and sometimes over the graveyard. Eleven children thought sometimes it came toward you, or sank back into the sky as they watched it.

3. Connection with Weather.

The superstitions connecting the changes and appearance of the moon with the weather are so numerous and varied that it is impossible to recount them in detail. Moreover, it is unnecessary, as instances can readily present themselves to any one conversant with current folklore. The moon has been almost universally regarded as the principle of moisture, due partly to its connection with tides and partly to the moisture of night. The name Astarte, so important in oriental mythology, in addition to meaning the moon directly, contained also the idea of the watery element as opposed to the fire of the sun. The Mahommetans, according to Millius, held the ancient idea of the moon that it was a star full of moisture, with which it filled the sublunary regions. In India the tradition is universal. In China the moon is the head of the Yin system of which water is a part. Says Grimm: "Water, an essential part of the Norse myth, is wanting in the story of the man with the thorn bush, but it reappears in the Carniolan story cited in Bretano's Libussa; the man in the moon is called Kotar, he makes her grow by pouring water." Among the early inhabitants of this continent, the universality of the belief is well known.

In the book on "Weather Lore," by Richard Inwards, there is a large collection of proverbs pertaining to the moon, of which we will quote a few of the most striking.

Circle near, water far;
Circle far, water near.—*Italy.*

The moon with a circle brings water in her beak.

The moon, her face if red be,
Of water speaks she.—*Zuñi Indians.*

Pale moon doth rain,
Red moon doth blow,
White moon doth neither rain nor snow.—*Latin Prover*

A fog and a small moon
Bring an easterly wind soon.—*Cornwall.*

If the moon change on a Sunday, there will be a flood before th month is out.—*Worcestershire.*

Saturday's change and Sunday's full
Never brought good and never wull.—*Norfolk.*

If the full moon rise pale, expect rain.
Sharp horns do threaten windy weather.

It is sure to be a dry moon if it lies on its back, so that you can hang your hat on its horns.—*Welsh Border.*

If the moon show a silver shield,
Be not afraid to reap your field;
But if she rises haloed round,
Soon we 'll tread on deluged ground.

The full moon brings fine weather.

4. THE MAN IN THE MOON.

There is reason to believe that a more universal animistic tendency preceded the anthropomorphism which lies at the foundation of most legends pertaining to the man in the moon. The stories familiar to us have deep-lying roots in Aryan mythology, which in the earliest accessible Greek and German forms, apart from vulgar variations, are highly wrought and extremely refined. With more primitive peoples the animistic concept takes the form of lower animals to almost as great extent as that of man. The hare has been a great favorite in all parts of the world, and especially among the common people of India. Says Max Müller: "As a curious coincidence it may be mentioned that in Sanskrit the moon is called Sasānka, *i. e.*, 'having the marks of a hare,' the black marks in the moon being taken for the likeness of the hare." The toad, mouse, cat, lion, bear, fox, have each been seen in the moon, and been the subject of folklore stories. That the reports from children refer to a human form only is probably due to the fact that the story of the man is told them at a very early age. Still this collection of expressions is one of the very best illustrations of the way animistic concepts must have grown up originally. Some of the expressions might stand, word for word, for some of the primitive legends.

Children pick out eyes, nose and mouth in the dark shades of the disk. It is a man's face, a woman's, a child's, angel's or God, etc. Nine children see in it the face of a dead parent or other relative. It is a whole figure of a man or woman leaning over and covering its face and crying, perhaps over the spilled milk of Jack and Gill, or one is bent, laughing, over the prostrate form of the other.

F., 16. The man was inside and showed only his face. I puzzled a great deal how it could be a man when all poets call the moon feminine.

For F., 12, the moon's face had the map of Europe, Asia and Africa, and a human face.

For F., 7, he was just a man sitting before a big open fire-place warming himself.

For M., 10, it is a man because you can see his long sandy whiskers, if your eyes are good enough.

For M., 7, it is only a small child, and no one can tell whether it is a boy or a girl.

M., 9. It must be a man to be strong enough to give light so far.

F., 7. The moon is made out of a man and the sun out of a lady.

F., 7. We know it is a man because God put him there all alone always, for gathering sticks laughing.

For one, as a boy, it was always a muffled female form with the head heavily veiled, half sitting before some prostrate form, so that the impression was always rather sad. It is the same yet, and he can see no other form. An adult watched the moon for years to see the man's wife and came to dislike him, because he always left her at home.

F., 19. When about 12, I could clearly see a lady's face in the moon, the man was fainter. I thought they were on their honeymoon.

F., 10. The moon must be a man because it is bald-headed.

F., 19. It seemed to me something in front of a face which was behind looking through, and I thought her body was behind it extending straight out behind the face into the sky.

M., 9. He peeps his head out through the sky with his body behind it. Sometimes he looks at us and sometimes he goes to sleep so, with his head out of the clothes.

M., 6. Thinks it the face of Jesus looking out of heaven, seeing everything but looking so kind.

F., 11. The moon man sees and knows everything, but is alone and looks cold and sad. I would like to go up and take care of him.

M., 3, says it is George Washington; M., 4, thinks it Moses; M., 4, thinks it the funny man or Punch; three think he is Santa Claus; two think him a jolly leering kind of a drunkard; one says he is only a candy man; one, Jacob; two, a rabbit.

F., 9. It is a face I know. I love to play with him and I talk to him a great deal.

M., 4. Insists he smokes a pipe and keeps a cow that jumps over a rock.

F., 20. From five to eight or so, I talked and shouted a good deal by spells to the man in the moon, and thought he could hear although he did not answer.

F., 21. I longed to ask him if he was not tired, cold and lonesome, and sorry he gathered sticks on Sunday. I thought God ought to put others there to help him pick wood, and finally thought I saw them.

F., 12. I used to think there was a real man in the moon, and made wishes to him, but now I know it is only the picture of a man.

F., 35. My girl, age nine, has long wanted to tell the man in the moon something, but will not tell me what.

F., 16. I used to think that when the moon looked red, as in rising, the man was very angry; and when it looked far and pale, I thought him sick and wanted to offer him a glass of milk.

F., 20. Used to think he had headache because the clouds bumped his head.

F., 19. Never dared make a face at the moon lest she should be struck dead.

F., 18. I thought the man must love us because the moon shines so gently down on us.

F., 23. Could never understand why the man in the moon and his friends did not fall off, as their heads had to hang down so much.

F., 6. The moon has parties sometimes. He draws a big ring around and admits only a few stars, and perhaps puts on a veil so that we cannot see their feast.

F., 16. Heard it was good luck to courtesy to it and call it lady moon.

The cow, milk and butter as well as cheese are associated in many fantastic ways with the moon, and even the dog's dish and spoon, cat and fiddle, occasionally appear. The man looks like some neighbor, burns brush, gathers sticks, etc. For a few it is just a head cut off, and for others the moon is made for an invisible man, to play with. Many hear of a certain form or face there and peer and strain their eyes, trying to look under, back and around to trace out parts, as we do constellations, failing perhaps to find legs, eyes, finding this too round, that too flat, etc. The man with sticks is sometimes seen, and the spots are smoke from his pipe or a fire there.

Modern European stories of the man in the moon are probably rooted in the Scandinavian legend which still persists in the familiar story of Jack and Gill. Mâni, the moon once took up two children from the earth, Bil and Hjuki, as they were carrying the bucket Soeg and the pole Simul from the well of Byrgir. The resemblance to the common nursery rhyme is obvious. Mr. Baring-Gould says, "This verse, which to us seems at first sight nonsense, I have no hesitation in saying has a high antiquity, and refers to the Eddaic Hjuki and Bil. The names indicate as much. Hjuki, in Norse, would be pronounced Juki, which would readily become Jack; and Bil, for the sake of euphony and in order to give a female name to one of the children, would become Jill. The fall of Jack, and the subsequent fall of Jill, simply represent the vanishing of one moon spot after another, as the moon wanes. But the old Norse myth had a deeper signification than merely an explanation of the moon spots. Hjuki is derived from the verb jakka, to heap or pile together, to assemble and increase; and Bil, from bila, to break up or dissolve. Hjuki and Bil, therefore, signify nothing more than the waxing and waning of the moon, and the water they are represented as bearing signifies the fact that the rainfall depends on the phases of the moon. Waxing and waning were individualized, and the meteorolo cal fact of the connection of the rain with the moon was represented by the children as water-bearers. But though Jack and Jill became by degrees dissevered in the popular mind from the moon, the original myth went through a fresh phase, and exists still under a new form. . . . . The girl soon dropped out of popular mythology, the boy oldened into a venerable man, he retained his pole, and the bucket was transformed into the thing he had stolen—sticks or vegetable.'' This view is supported by Grimm and other authorities.

5. THE MOON AND MORALS.

F., 18. I thought the moon smiled at good girls, and frowned at us if we were bad. Often I could not feel sure which it did, and would ask mamma if I had been good or bad that day.

M., 20. Used to think if he was bad it would come close to earth and punish him.

F., 19. If good, it came near; if she was bad it went back into the sky.

F., 14. Used to think it shone bright if she was good, and was pale if she was bad.

F., 17. Was ashamed and afraid to have the moon see her misbehave or know of her bad acts.

Often children think the moon goes away, or has the clouds cover it, as a punishment for their sins or because it is saddened by them. On dark nights their conscience troubles them. It can see through clouds and houses, and may draw us up as a punishment to work with the stick gatherer. It sees naughty acts far more surely than good ones. It spies, watches and follows us wherever we go, even when we sleep. Bad children try to run away from it, but in vain. Young women, whose windows open only to the sky, draw the blinds so the moon will not see them undress, but one loves to expose herself to it. If children are bad, it looks straight at them. It may not be able to tell who we are, it is so far away; but it is made light so it can see us, and perhaps see our hearts and thoughts. It can look everywhere, and cannot only tell us what our friends at a distance are doing, but their thoughts and feelings. It may have special times to watch us and overlook us at others. It reports to God, Santa Claus, tells the stars. It is bolder than the sun, for it goes out nights.

Here the chief moral elements seem to be, first, an all-seeing eye, second, the hiding or absence of the moon for which they felt themselves responsible. The idea of moral example in the suggestion of being taken up to work with the stick-gatherer is not certain.

In the folklore stories, the moon is frequently regarded as the witness of wrong-doing, the sufferer for wrong-doing, or a warning to wrong-doers. The stories of the thief also furnish definite cases of moral example. The following Icelandic legend from the collection of Jón Arnason, gives an instance of the moon avenging directly a case of robbery and effrontery. "There was once a sheep-stealer who sat down in a lonely place, with a leg of mutton in his hand, in order to feast upon it, for he had just stolen it. The moon shone bright and clear, not a single cloud being there in the heaven to hide her. While enjoying his gay feast, the impudent thief cut a piece off the meat, and, putting it on the point of his knife accosted the moon with these godless words:

'O moon, wilt thou
On thy mouth now
This dainty piece of mutton meat?'

Then a voice came from the heavens saying:

'Wouldst thou, thief, like
Thy cheek to strike
This fair key, scorching red with heat?'

At the same moment a red-hot key fell from the sky on to the cheek of the thief, burning on it a mark which he carried with him ever afterwards. Hence arose the custom in ancient times of branding or marking thieves." The moral quality of the following from the Chinese is unmistakable:

"*Ming Li of the House of Wei*
"Reigned 227-237 A. D.

On an Eclipse.—A Rescript. We have heard that if a sovereign is remiss in government, Heaven terrifies him by calamities and strange portents. These are divine reprimands sent to recall him to a sense of duty. Thus partial eclipses of the sun and moon are manifest warnings that the rod of empire is not wielded aright. Ever since WE ascended the throne, OUR inability to continue the glorious traditions of our departed ancestors and carry on the great work of civilization, has now culminated in a warning message from on high. It therefore behooves US to issue commands for personal reformation, in order to avert the impending calamity.

"But the relations of Heaven with man are those of a father and son; and a father about to chastise his son would not be deterred were the latter to present him with a dish of meat. WE do not therefore consider it part of our duty to act in accordance with certain memorials advising that the prime minister and chief astronomer be instructed to offer up sacrifices on this occasion. Do ye, governors of districts and other high officers of State, seek rather to rectify your own hearts; and if any one can devise means to make up for OUR shortcomings, let him submit his proposals to the Throne."

The awful example of the man in the moon as Sabbath-reaker and thief is, of course, familiar in every nursery. The ory has many versions, but the same idea. The one best nown is supposed to have scriptural warrant, the passage which is its foundation being Num. XV, 32:36. We are told hat the man found by Moses gathering sticks on the Sabbath was transferred to the moon. The passage cited merely states hat the man was stoned by the congregation, and makes no mention of the moon. The story seems rather to be of Teutonic rigin. The ordinary German story is that a man went out ne Sunday ages ago into the wood to gather sticks. Having ut a fagot he slung it over his shoulder on a staff. On his way home he met a man in Sunday clothes walking toward hurch. "Do you know that this is Sunday on earth when ll must rest from their labors?" he asked the wood cutter. "Sunday on earth, or Monday in heaven, its all one to me!" was the reply. "Then," said the stranger, "bear your bun-le forever. And as you value not Sunday on earth, yours hall be a perpetual moon-day in heaven; you shall stand for ternity in the moon, a warning to all Sabbath-breakers." Whereupon the man with his staff and bundle was caught up nto the moon, where he stands yet." (Proctor Myths and Marvels of Astronomy.)

Mr. Baring-Gould in his "Curious Myths of the Middle Ages," gives a slightly different version of the story, from Schaumberg-lippe, in which we are told that there is a woman with the man in the moon. The man is there because he trewed brambles in the church path on Sunday morning; the woman because she made butter on that day. A similar tale is old in Swabia and in Marken. He cites Frischart as saying hat there "is to be seen in the moon a mannikin who stole wood." Among other German tribes it is told that he stole abbages, or willow-boughs or sheep. With reference to the tory in Great Britain, Harley cites Alexander Neckam, an bbot, born in 1157, who thus describes the popular belief: "Nonne novisti quid vulgus vocet rusticum in luna portantem pinas? Unde quidam vulgariter loquens ait,

Rusticus in luna
Quem sarcina deprimit una
Monstrat per spinas
Nulli prodesse repinas."

The following lines from the "Testament and Complaint of Creseide," whose authorship is sometimes ascribed to Chaucer, re spoken of Lady Cynthia or the moon:

"Her gite was gray, and full of spottis blake,
And on her brest a chorl painted ful even,
Bering a bush of thornis on his backe
Whiche for his theft might clime so ner the heaven."

According to Baring-Gould, the moon has always been associated with the idea of theft in the Norse mythology, and the figure seen in the moon came easily to be regarded as the thief. The Bible story of the stick-gatherer later supplanted the theft with Sabbath-breaking. How the idea of theft originally grew up in connection with the moon must, of course, remain largely conjecture, but the psychology of the process is not far to seek if we remember the statements of children at the beginning of the section. The idea that the moon knows what is taking place on earth is almost universal. This probably arises from the suggestion of an eye, and the moral effect is the same as in the ordinary statement, "God sees you." The majority of thefts are likely to have been committed at night, and the presence of the same spectator would establish a close line of association. This would also account for its being made an external conscience, because it would recall the former act and its associated moral quality.

6. PLACE OF DEPARTED.

Wherever the idea of the moon as a *place* has appeared, it has almost invariably become connected with ideas of spirit inhabitation. It is sufficiently familiar to stimulate, and sufficiently remote from certainty to permit the freest play of fancy.

Children from eight to fourteen or so, develop ideas of what is in the moon. A few think they can see people move in it; some think dense forests; small people live in it, or odd, fairy, dwarf or other fantastic personages, as people without heads or all head. Its population increases or decreases. It may be full of beautiful angels. Often there is much music made by the people, or by the moon and stars. God lives or sleeps there. The people keep the lamp, like light-house keepers; or brighten it by letting the sun shine through it; or clean off the dirt that we can see from its contact with black clouds. Old and crooked people, or the souls of the dead, or of babies live there. All its inhabitants are pale and rather sober and sickly. When it goes the other way, they will straighten up. Its weather is hot or cold as ours is, and it is often smoky. Some think it a penal colony of Sabbath breakers, or can see them behind prison bars. A girl was terrified, because when looking at its shadow in water, it seemed to shake. Frequently the face of a dead parent or dead friend shows itself.

F., 16. Used to think it a big eye glaring at her, and later heard it was full of dead people.

Any one of these suggestions, given a receptive and responsive environment, might easily grow into a definite belief about another world or future life.

The folklore stories vary considerably as to detail but have the same central idea. Just as with children it is the place of the unusually strange or unusually beautiful. Lucian the Greek satirist wrote a book on the "Voyage to the Globe of the Moon," in which he describes it as a great round and shining island which hung in the air and yet was inhabited. These inhabitants were of a most fantastic order, were called Hippogipians, and their king was Endymion. Others of the ancients thought the lunar men and plants were of an immense size. Generally, however, the moon as a place stands in a much closer relation to the earth, and becomes a sort of hades or receptacle for the departed. In the Egyptian "Book of Respirations," Isis breathes the wish that the soul of her brother Osiris might rise to heaven in the disk of the moon. Plutarch tells us that the moon is the element of souls which resolve into her as the bodies of the dead resolve into the earth. Johanna Ambrosius, the German peasant-poet, prays in one of her poems that when she dies she may spend eternity in the moon. Mr. Tylor tells us that the Saliva Indians, of South America, point out the moon as their paradise where no mosquitoes are, and the Guaycurus show it as the home of deceased chiefs and medicine-men, and the Polynesians, of Tokelaŭ, in like manner claim it as the abode of departed kings and chiefs. A common mediæval conception made the moon the seat of hell, and Plutarch mentions an ancient theory that hell is in the air and elysium in the moon.

This brings us to a circle of the most beautiful conceptions in the whole range of mythology, the paradise stories of the different races, in each of which the moon has played a more or less important role. The two things necessary in the construction of a paradise seems to be trees and brightness. Some among the ancients said that the bright patches on the moon's face were plains, and the lunar spots forests, Diana's hunting-ground. Captain Cook says that many among the South Pacific Islanders regard the moon-spots as splendid groves of trees which once grew in Otaheite, but are now extinct. Others, according to Ellis, suppose the moon is a beautiful country in which grows the aoa, the most stately object in a Tahitian landscape. We have already referred to the Greek elysium, the plain far in the west, with its asphodel meadows and eternal sunset sky, the isles of the blessed sailing in a sea of blue and wrapped in burnished clouds, the blissful land where Odysseus and Laertes, Achilles and Hector meet, and all enmities are forgotten. The paradise of the Pacific Islander is essentially the type of all the others, the Hindoo Meru, the Persian Heden, the Chinese garden, the Hebrew paradise, and the Christian heaven.

7. EMOTIONAL REACTIONS.

Its presence makes small children, three to eight and older, feel "nice," "happy," "jolly," "splendid," "good," and rarely "sad." They jump, shout, run, laugh aloud, lose their usual sleepiness, are usually good tempered and often excited to the point of abandon. The excitement of the light may almost intoxicate. Sometimes, at this stage, it is said to be not beautiful but just pretty, because so round, bright and large. Only older children gaze and languish.

F., 9. The moon makes me think of love, because the man and woman in it make love and will marry sometime.

F., 11. The moon is sad, because she is the sun's wife, and he is proudest and they do not live together.

F., 16. I go out on the piazza or further, when the moon is there, for I feel it will take care of me.

F., 17. I used to think of the moon as very tall, blonde, a lady, proud and cold, and feared by all the stars. Now, at sight of her, I want to be silent and have the old feeling.

F., 15. I thought the moon saw us and changed its expression while looking at us. I remember, about ten, lying abed and making faces at it. The more terrible faces I made, the more the moon smiled. This made me angry.

F., 5. I love to make faces at the man in the moon. He laughs and comes down and kisses me.

F., 16. Once I was looking at the moon and I saw the man in it smile. I ran and told mamma the moon man was laughing at me. But I watched and found he was always smiling, so I knew he was pleasant.

Eight other children think they have seen the moon smile or laugh.

M., 29. The sight of the new moon always gives me a thrill of pleasure, and causes me to smile. The feeling is so intense that often I feel my hands clinching, my body growing tense, and I utter an involuntary ah. I wish I could account for it.

F., 26. Moonlight, especially if I am alone, makes me sad. Is it my unworthiness and littleness at sight of the wonders of the heavens? I long to be more deserving of their blessings and beauties.

F., 20. Loves to sit and watch the moon and make all sorts of fancies about it; how it is the oldest and biggest star, but all are growing to its size; how it is their mother, and sometimes gets angry with her children; how I would like to go up there and what I would do; about trees, houses, flowers and people there; how I would swish on a swing hitched to it, etc.

M., 5. I want to go right up and fly round heaven with it. I always say, "Ah, pretty, pretty moon."

M., 7. When I see it bright and pretty it makes me feel good and nice. I want to go right up there, and feel as if I must go at once.

F., 8. I love it very much, so much that I want to visit it, and often get a lump in my throat.

F., 21. It is soothing, sympathetic and tender, and its light is so soft and mild that it must love everybody and everything. It makes me good and rests me. Sixteen children want to go up to the moon. It draws, or they want to see what it is made of, they feel homesick or long for it.

F., 19. Feels awe and wants always to be still, quiet and alone awhile with every moon, and sometimes stretches out her arms to it.

F., 13. Loves it, because she heard how it loved a weary mouse, a pair of lovers, a convict, some lost children and a belated traveller.

M., 5. Misbehaved, was scolded, sulked and went out on the porch, and was overheard to say, "old moon you might cover your face, so she would not have seen me," and a few moments later, "I will make all the faces at you I want to and you can't hurt me."

M., 5. Ran suddenly out doors to hide, in a game, and found a bright moon, and shouted "get out of the way, there, you saucy old thing, or I will give you a slap."

M., 15. Used to go out and talk to the moon if in a bad humor, told all her secrets and told him not to tell.

F., 18. The moon looked to me like a funny, puffy, little man, with fat cheeks, laughing from ear to ear, with small twinkling eyes, and a broad forehead much wrinkled. I used to tell him or wanted to tell him all the funny jokes I heard, especially about him, and ask him what sort of a time he had.

F., 18. Used to want to hug and kiss the moon, and once asked it to marry her.

F., 19. Never could endure to look at or even think of the moon if away from home. It made her homesick and intolerably sad, it seemed so cold and friendless up there.

F., 21. Still wants to cry and go off by herself, sit still and watch it and think.

F., 19. It has a strange fascination for me. I cannot take my eyes off it.

F., 18. When I see it clear and bright, I feel good, partly because I think we will have good weather. I would like to take a walk with my beau if I had one.

F., 12. I always want to go out walking or riding, or see some one.

M., 27. I never can bear to go to bed when the moon is at its best. It seems like wasting opportunity to do something, or at least to saying it.

M., 29. To be honest, I always think of the girls when it is moonlight, and where I would like to go and what do with one or another of them.

F., 19. I used to cling to mamma, now I feel sad but enjoy it in spite of my tears. I do not know why my heart goes out to it so.

As regards emotional reactions among primitive peoples, a single quotation from Mr. Tylor will suffice. "Negro tribes seem almost universally to greet the new moon, whether in delight or disgust. The Guinea people fling themselves about with droll gestures, and pretend to throw firebrands at it; the Ashango men behold it with superstitious fear; the Fetu negroes jumped thrice into the air with hands together and gave thanks."

8. Effect of Phases.

The monthly increase and decrease constitute, perhaps, the most obvious fact pertaining to the moon.

The quarters when noticed by children are variously explained. It is sometimes thought to be slowly made a part at a time, or the mice have eaten half; it is hammock shaped for the man in the moon to rock in, or to rock his baby in; there are several moons, wholes, halves, quarters, etc., it does only half duty or loses part when the sun is out; it shows only part, or gets small when it is going to rain; or the part that is cut out goes to sleep and a part must be always on duty; new moons are just born or full ones are made out of worn out rims of old ones; it gets starved, thin and lean; it dies out and then comes to life again; the moon man draws the curtains part way or all the way when he goes to bed.

It eats, and you can see the teeth in its horseshoe mouth, or else its mouth is a mark on the full moon. Its chief food is cheese, but it also eats mice, stars, buckwheat cakes, cookies, and other round things so as to get round itself; or it eats pumpkins and lemons, because it is yellow or to get yellow; or catches birds; or eats pieces out of the sky; it eats off a big round and perhaps yellow table; and may eat bread, butter, oatmeal, candy, ice cream, drink milk out of a round cup. When it gets thin, it has done wrong and God withholds food. It may wear a mask and eat through that, drink up the rain or dew.

F., 29. Once thought things grew big and small, as the moon did.

The absence of the moon by day or by night is hard to explain, when noticed. Younger children think it is abed, undressed, asleep, etc., or that God had not hung it out. It relieves the sun as a night watchman, so it can go to bed, they arrange it between them so one shall be there. In storms or when we do not see it, it is shining in heaven on the other side of the sky or somewhere else, or the rain puts it out, or it retires to avoid darkness and storm. When it looks pale, it is just waking up, and has hardly got its eyes open. It may be behind the sun, while by night the sun is behind it. It gets very tired sometimes from the effort of shining, but more often from its journeys. It darkens the sky so it can sleep. One pictured the room it slept in, with a white bed, stove, lamp, etc. It shuts its eye so we cannot see it, and uses clouds for sheets and blankets. One could not conceive how it could know when to get up. It spends the night in the ground or in the water. When it does not shine, it is sick or the sun will not give it the light it begs for. God does not like to expose it to danger or dark and storm and shuts it up. Rain may wet it and give it cold.

Waxing and waning are reflected in nearly all the stories and are variously accounted for. In some it is the central fact to be explained. Two or three examples will suffice. Among the Khasias, of the Himalaya Mountains, it is told that the moon, who is a man, commits the unpardonable offense of falling in love with his mother-in-law every month. That commendable lady very properly reproves him by throwing ashes in his face. There is a similar legend of Slavonic origin in which the moon is unfaithful to his wife, the sun, loving the morning-star instead, and for punishment is cut with a sword. Among the Greenlanders, the sun and moon were once human beings, sister and brother, named Malina and Anninga. The latter while playing in the dark, seized his sister by the shoulders, a sign of courtship. In order to recognize him, she smeared soot on his face which accounts for the spots. When she discovered who it was, she fled to the sky, becoming the sun, closely followed by Anninga, who became the moon. The chase at times makes him very hungry and thin, when he gives it up for a few days to hunt seals. This fattens him, and he becomes the full moon again. Among the natives of Encounter Bay it is told that the moon is a woman living a dissipated life among men, which causes her to grow very thin, whereupon she retires for awhile, or rather is driven away, to recover her plumpness, when she resumes her gay life. A well known savage myth is that in which the moon tells men through a beast that though they die, like her they shall live again.

The effect of the moon's phases on common folklore is almost inconceivable in extent. It stands always as the symbol of fickleness, especially of increase and decrease, growth and decay. It is only a short transition in association from the symbol to the cause, so the moon has exclusive control of all undertakings in which these factors enter in. Says Harley: "The *new moon* is considered pre-eminently auspicious for commencements,—for all kinds of building up, and beginning *de novo*. Houses are to be erected and moved into; marriages are to be concluded, money counted, hair and nails cut, healing herbs and pure dew gathered, all at the new moon. Money counted at that period will be increased. The *full moon* is the time for pulling down, and thinking of the end of all things. Cut your timber, mow your grass, make your hay, not while the sun shines, but while the moon wanes; also stuff your feather bed then, and so kill the newly plucked feathers completely, and bring them to rest. Wash your linen, too, by the waning moon, that the dirt may disappear with the dwindling light." From the Greeks down the new moon has been considered the proper time for marriages and births. Among the Druids, according to Forbes Leslie, "the moon, in the increase, at the full, and on her wane, are emblems of prosperity, established success, or declining fortune, by which many persons did, and some still do, regulate the period for commencing their most important undertakings." In Gealic the word for fortune is derived from that which means the full moon. Numerous superstitions exist as to the way the new moon must be first seen, with various incantations, and methods of prognosticating the future.

While dealing with the general question of the moon's influence upon human fortune, it may be well to refer to the wide-spread astrological superstitions pertaining to its effect upon the body. The chief organ that it governed was, of course, the brain, but it had a secondary control of several others. The words "lunacy" and "mania" are of direct derivation, and even now we speak of a person as being "moon struck." That all forms of insanity are traceable to this influence, is a very ancient belief. An interesting example of the ancient practice of medicine is given by La Martinière, quoted by Harley. "This lunar planet," says this author, "is damp of itself, but, by the radiation of the sun, is of various temperaments, as follows: in its first quadrant it is warm and damp, at which time it is good to let the blood of sanguine persons; in its second it is warm and dry, at which time it is good to bleed the choleric; in its third quadrant it is cold and moist, and phlegmatic people may be bled; and in its fourth it is cold and dry, at which time it is good to bleed the melancholic." The light of the moon seems to have been almost universally considered detrimental to health, and nearly all the maladies in the catalogue were within its power to inflict.

9. Moon-Worship.

To determine the necessary processes and fundamental stages in the development of a religion is the paramount problem in the new science of religions. Without involving questions as yet unsettled by investigators in this field, we may refer to certain generally conceded facts. One of these is that every religion is a *growth* involving a great complexity of elements. Again, it stands as the final output, so to speak, of a people's life, and is the ultimate organizing element in any particular period. After a more or less diffused growth, each of the great ethnic religions seems to have been summed up, recast, and individualized by a great personality. While it is possible to follow back the line of development and find elements that had been assimilated to a larger system, it is also, to some extent, possible to approach these elements from the side of their psychological beginnings. Thus the sex-instinct which even now stands so near to the religious sentiment, shows its enormous significance historically in the forms of phallicism so prevalent in some periods. It is, of course, one of the problems of psychology to determine what in the individual is the raw material of which religion is later made. The existence of an original religious instinct is altogether without evidence. As with races, so with individuals, it is a growth not only through childhood, but through the entire life. That children at an early age pray to the moon, is evident from many of the reports, but just what a prayer means at this age is doubtful. Several thought the figure in the moon was God, or Christ, or angels. It is probable that the elementary feelings are a sense of familiarity, sympathy, responsiveness, and a desire for help. The following examples are illustrations of what is meant.

F., 18. I took great pleasure, aged twelve to fourteen, sitting by my window and telling the moon all my school girl troubles, and asking different things. He would smile and encourage me.

F., 11. I always want to talk to the moon, and sometimes do. I always say "shine on." F., 18, used to say, how do you do, aloud to the moon. F., 9, says, where are you going, aloud. M., 5, was heard to ask the moon its name. F., 7, used to say "I want you." F., 15, used to tell the moon all her troubles. F., 22, used to "tell and ask many things." F., 9, asked many questions and talked all about toys and dolls (she was an only and neglected child). When F., 19, first learned things, she used, as a child, teach them to the moon. F., 5, would sing and talk to the moon, and ask it to give her cake and ice cream, and beg it to come and play with her. Children pray the moon to shine, so they can see to go somewhere, or so they will not be afraid. "Take me with you" is another frequent invocation. To look over the right shoulder and wish for things is very common. F., 19. At six and eight, my sister and I were left alone till into the evening by our parents being delayed. We asked the moon where they were, and I shall never forget the strong impression of anxiety with which we watched to see if he would tell us.

It is an easy transition from the simple accounts of natural phenomena embodied in myths to the organization of these into more or less complex systems. Among these primitive formations one would expect to find unusual importance attached to myths of the sun and moon, the rulers of day and night, the most continuously present facts of man's natural environment. That this was the case among many peoples cannot be doubted. The ruins of many ancient temples abundantly attest the great antiquity of this form of worship. Some authorities maintain that luniolatry preceded the worship of the sun. Says Mr. Tylor, "Moon worship, naturally ranking below sun worship in importance, ranges through nearly the same district of culture. There are remarkable cases in which the moon is recognized as a great deity by tribes who take less account, or none at all, of the sun."

Among the ancient Egyptians the sun and moon worship seems to have been the earliest form of religion. There were two moon-gods, Khonsu and Thoth. All representations of these deities show them with the crescent, and Thoth was the keeper of time. The cat, well known as one of the sacred animals among the Egyptians, was dedicated to the moon. The sun and moon appear very frequently on ancient Assyrian monuments as sacred symbols. The Chaldeans were undoubtedly moon-worshippers, the names of the deity being Sin and Hur. The latter was also the name of the Chaldean capital.

The name for the moon in Syriac at the present time is Sin. Many think it appears in Sinai, and that this mountain was consecrated to the moon. The fact is very important in view of the part Sinai played in the Hebrew religion. But there is more positive evidence of the existence of luniolatry among the Hebrews. There is frequent reference in the Scriptures to the "host of heaven," to the "queen of heaven," to Astarte or Ashtaroth, the moon-goddess of the Phœnicians. Ancient writers, as Lucian and Herodian, identified the latter deity with the moon. There is reference in Genesis to Ashtaroth-Karnaim, meaning Ashtaroth of two horns. The symbol of Astarte was the heifer with the crescent horns, the worship of which continued almost throughout Hebrew history. The crescent was one of the most common of ornaments.

The personification of the moon among the Greeks crystallized in two well-defined myths, those of Selênê and Artemis, each characterized by that delicate and refined symbolism which gives its greatest charm to Greek mythology. Says Cox of the Selênê myth, "As Endymion sinks into his dreamless sleep beneath the Latmian hill, the beautiful Selênê comes to gaze upon the being whom she loves only to lose. The phrase was too transparent to allow of the growth of a highly developed myth. In the one name we have the sun sinking down into the unseen land where all things are forgotten—in the other the full moon comes forth from the east to greet the sun, before he dies in the western sky. Hence there is little told of Selênê which fails to carry with it an obvious meaning. She is the beautiful eye of night, the daughter of Hyperion, of Pallas or of Helios, the sister of Phoibos Apollon. Like the sun, she moves across the heaven in a chariot drawn by white horses from which her soft light streams down to earth, or she is the huntress, roving like Alpheios, over hill and dale. She is the bride of Zeus, and the mother of Pandia, the full orb which gleams in the nightly sky; or as loving, like him, the crags, the streams and the hills, she is beloved by Pan, who entices her into the dark woods under the guise of a snow-white ram. In other words, the soft whispering wind, driving before it the shining fleecy clouds, draws the moon onwards into the sombre groves."

The same writer says concerning Artemis: "In some traditions Artemis is the twin sister of Phoibos, with whom she takes her place in the ranks of correlative deities. In others she is born so long before him that she can aid Lêtô her mother at the birth of Phoibos—a myth which speaks of the dawn and the sun as alike sprung from the night. Thus her birthplace is either Delos or Ortygia, in either case the bright morning land, and her purity is that of Athênê and Hestia. . . . .

Like Phoibos, she has the power of life and death; she can lessen or take away the miseries and plagues which she brings upon men, and those who honor her are rich in flocks and herds and reach a happy old age. From those who neglect her, she exacts a fearful penalty. . . . . In a word the colors may be paler, but her features and form generally are those of her glorious brother. With him she takes delight in song, and as Phoibos overcomes the Python, so she is the slayer of Tityos."

According to Pansanias, there was a worship among the Greeks of the Egyptian goddess Isis, which, if we can trust Diodorus, meant the moon with them. That moon worship persisted to a very late period is shown by the words of Socrates, who said at his trial, "You strange man, Melêtus, are you seriously affirming that I do not think Helios and Selene to be gods, as the rest of mankind think?"

The chief moon-deity among the Romans was Luna, sister of the sun. Both Pliny and Tacitus speak of temples consecrated to her worship. Another moon-goddess was Diana, corresponding to the Greek Artemis. Grimm, the best authority on the ancient Germans, tells us, "That to our remote ancestry the heavenly bodies, especially the sun and moon, were divine beings, will not admit of any doubt." Moon-worship appears among the rites of the Druids in Britain and Ireland. Its prevalence in China and among the American tribes is well known. There can be little doubt that vestiges of luniolatry appear in the Christian religion. A definite order was formed about the fourth century. The lower classes in the middle ages openly worshipped the moon, identifying her with the Virgin. In the Missal Mary is spoken of as, "Sancta Maria, coeli Regina, et mundi Domina." These illustrations will be sufficient to show how important the moon has been in the development of the religious consciousness.

10. THE MOON OF SCIENCE.

This fragmentary outline may, perhaps, be sufficient to show that the moon has been the subject of one of the most profound chapters of human experience. As a central object in that environment of which it has been and is the business of man to make account, it has been a continual stimulus helping to call out and fix some of the most elementary affirmations of the mind. That these same affirmations not only appeal to, but arise spontaneously out of the growing instincts of the child is almost beyond doubt. It becomes then a matter of considerable interest and importance to note the stage of transition from the primary animistic and mythical conception to that made necessary by positive science. The moon furnishes the best example in nature of a complete reversal of views. The transition is not so marked in the case of the sun which, on account of its manifold influences, stands as the type of perennial activity, or the stars and planets which with their great remoteness or possible inhabitation remain to some extent in the region of mystery and conjecture. But the facts concerning the moon, which science has assembled, deprives it of every vestige of anthropomorphic interest. We will recount a few of them.

The moon is our nearest neighbor, astronomically, its mean distance being 238,840 miles. Its diameter is 2,163 miles; surface $\frac{1}{13}$, and volume $\frac{1}{49}$ that of the earth; rotates on its axis once a month, in precisely the same time as required for revolution around the earth; phases due to fact that we can observe only that part of the illuminated hemisphere turned toward the earth at the time; light reflected, only $\frac{1}{15}$ as strong as earth-shine; atmosphere extremely rare, $\frac{1}{780}$ of pressure at earth's surface, probably absorbed in cooling; no water, also absorbed; temperature at end of lunar day about freezing point of water, at end of lunar night, 200° below zero; no signs of life. The surface is very broken; covered with great volcanic craters, some of which are more than 100 miles across; twelve great plains, called seas by Galileo; many deep valleys and cracks; some mountains reaching the height of 23,000 feet.

It stands as the great example of a worn-out world, and the type of what our own planet will ultimately become. The passage from the conception that treats the moon as a living personality with multiform influences upon human weal and woe to that in which it appears as only a dead stone, must necessarily be attended by much that is pathetic, because it marks the disintegration of one attitude toward nature and the inception of another. Every *eclaircissement* is a period of criticism and disruption. The historical counterpart of what appears in the life of every individual is to be found in the Greece of the Sophists and Socrates. The very statement that man is the measure of all things implies the realization that he has already lost his standard. The balance struck by Plato between the
thology and the new critical attitude is perhaps the rea-
significance as the philosopher who most truly re-
neaning of life. For us his work is important as
impossibility of destroying an attitude based in
nary series and standing as the ultimate outcome
eople's existence. The same reversion can be noted
her period of "enlightenment." Along with it
a marked treachery to the principle it is trying to
he most convenient lesson probably which modern
rned, is that of dividing his experience into sep-

arate compartments connected by blindfold passages. In one he keeps his rationalism, in the other the more neglected and, in some respects, the more important parts of his experience. A good example of what is meant is the enlightenment of the eighteenth century. A thoroughgoing mechanical scheme was good enough for the visible universe, but beyond it was that quintessence of the mythological heritage, a *deus ex machina*. That this is still the position of many, needs no more than to be indicated. It is more than suggestive that the chief impulse in the development of biology came from the impossibility of longer accepting the creationalistic mythology. The science of life undoubtedly appeals to something more fundamental in human nature than the mere desire to know. This development from mechanism to organism suggests the true direction the animistic instinct should take—that is, it should become a motive within science itself. The lesson of history is but partially learned if we fail to perceive that an *eclaircissement*, whether in individual or racial life, is nothing more than a momentary disruption preliminary to a new adjustment, and a disruption that might in most cases be avoided. After all, the raw material of knowledge, even scientific, is not externally gathered, but to be found within man himself, made by a process of development into established forms. An excellent illustration of what it meant is the subject we have attempted to treat. The moon, considered solely with reference to itself, has been before the human mind from the beginning just as it is now. It has been, so to speak, a fixed point about which human nature has made its revolutions. It would seem, to be sure, that science has brought all such movements to a complete stop, but the moon-lover need not be pessimistic. He should remember that the romantic attitude toward nature came directly from the heart of the mechanicalistic movement, and, while Schelling could no longer be accepted, the last century showed the most genuine feeling for nature known since the Greeks. If the animistic instinct cannot surmount a wall, it is likely to find a way around it. Even now, it means no more to the person of deep æsthetic feeling to say that the moon is a barren body of matter than that a landscape is composed of inanimate objects, or a symphony of vibrations, or a painting of canvas and pigment. Again, the meaning of matter is by no means clear as yet; its supposed deadness may be merely accidental. If one wished to press the question, he might insist with some justification that the characteristic concepts of science are ultimately mythological agencies. Certainly some of them are not distant many removes. Our sole object here, and indeed the whole value of the study, if it has any, is to show the complete relativity of an object in nature

LITERATURE.

of Metaphysics, by J. S. MACKENZIE. Published by Macmil-
nd Co., New York and London, 1902.

ok is a study of the problems of metaphysics from the stand-
he philosophical thought of the day. It centers round the
relating to experience, and advances a step on Bradley in
enabled through its use of the genetic method to gain through
f the becoming of experience a new light on experience, not
erience, perhaps, but more significance in experience. And
a thorough study of experience by the genetic method, bring-
l its phases, he studies the forms of the constructive activity,
uild up their interpretations of experience, from the stand-
he whole of experience.

rk opens up with a provisional definition of metaphysics,
t is the science that seeks to deal with experience as a whole,
as a systematic unity. After discussing the special sciences,
how all deal with only a part of experience, he changes his
of metaphysics by saying metaphysics is the science which
take a comprehensive view of experience with the view of
nding it as a systematic whole, by experience understanding
ience of an individual yet an experience common to all, indi-
t universal. With the seeming fundamental duality of expe-
subject and object, mind and matter, and on the other hand
qually seeming unity arises the first great problem of meta-
namely, that of their reconciliation. Some attempts have
lism, Inonism, Agnosticism, Materialism, Idealism, Trans-
ism. What we want, says MacKenzie, is not a Theory
edge but a Theory of Experience. What we want, then,
od which will enable us to arrive at the solution of our prob-
ioned above. (a) Early dialectic method, (b) dogmatic meth-
ychological method, (d) critical method, (e) later dialectic
ave been tried and found wanting, and since we want to study
e from the point of view of its becoming as well as what
s, and also since it was the method led up to by the develop-
oth ancient and modern philosophy Aristotle and Hegel; and
eeps us in touch with the concrete content of experience the
ethod seems by far the best; therefore it will be our method.
o consider 1st the genesis of experience, asking two questions:
oes experience of a world grow up? (b) the significance of the
lements in its development? Before answering the two ques-
us restate our problem. The problem is to try to understand
al significance of our experience as a whole by observing the
f its development. In answer to the first question we would
ave (a) the simple emergence of a manifold content in con-
s.

ntent is always somehow presented within a unity but there
be any conscious reference to such unity, the presence of the
ng shown in that the content presented is not bare or cold
lways an effective side, (b) this consciousness of harmony or
e is seen, on reflection, to be connected with changes that take
n within in the content of our experience. In answer to ques-

tion two we have the three elements (a) simple presentation in consciousness, (b) feeling, (c) conscious activity; simple presentation being the most significant in the first stage, feeling in the second stage, conscious activity in the third stage; and, as the third stage is the most important, and since it is to thought experience we must hope for metaphysical enlightenment, conscious activity is the most important and most significant element. The three stages of development are (a) sensation, (b) perception, (c) conception. Nine problems seem to be involved in sense-experience, seven in perception, four in thought. While all the problems of the two lower stages are involved in the highest stage (thought), the advantage of rising to this problem through a genetic study lies mainly in the fact that it enables us to put the whole of our material before ourselves in proper perspective. Metaphysics is the criticism by thought of its own constructions, thought being considered as the culminating point in the general process of experience. The chief value of a genetic survey lies chiefly in the fact that it enables us to have definitely before our minds a connected view of experience as a concrete whole. Again it abolishes the fundamental distinction between mind and matter, and the apparent fundamental antithesis between apparent duality and equally apparent unity of experience, for both the world of mind and matter are ideal constructions. What we have to do is to take mind and matter as elements in the totality of our experience and try to see what place belongs to each within the concrete system of our world. Most fundamental antithesis is that between the That and the What. Yet nowhere in our experience have we pure Thatness or pure Whatness. The development of experience is from the less to the more determinate by the introduction of more and more definite constructive forms. We have certain constructive activities involved in experience. As it is, the problem of metaphysics is that of considering and criticising the whole work of these.

Accordingly, the question for metaphysics is (a) What are the fundamental forms of construction in the building up of our experience? (b) How far is each of these forms coherent in itself and capable of being worked out? The forms of construction are (1) Perceptual, (2) Scientific Construction, (3) Ethical Construction, (4) Æsthetic Construction, (5) Religious Construction, (6) Speculative Construction. The second question is answered in particular in the remaining part of the book and his conclusions summed up as follows. There are certain difficulties in the constitution of human knowledge but at the same time there are indefinite possibilities of gradually removing such difficulties, or at least reducing them to a minimum. Take any construction by itself and it fails, take it in relation to the whole, for experience is an organic whole, and we may reasonably believe it does not fail. The book I wish to commend very highly, 1st because it realizes the ideal Prof. MacKenzie had in mind when he wrote it, for it was to be a book for the student just beginning seriously to face the problems of metaphysics. It lays out the problems in a clear manner before the student so that he knows what he faces and from what sources these problems rise. 2nd, for his use of the genetic method, the best possible method to gain a complete insight into the significance of experience. 3rd, for his recognition of the claims of all the constructive activities contained in experience. The plan of the book is admirable. It is the best book of its kind I have ever come in contact with. My only criticism would be that Dr. MacKenzie in one or two places has asked questions and then failed to give definite answers. He seems to have wandered away into something else. R. M. Moore.

Kant's Prolegomena. Edited by Dr. Paul Carus. Published by Open Court Publishing Company, Chicago, 1902.

A new translation of Kant's Prolegomena, by Dr. Paul Carus, with an Essay on Kant's Philosophy by Dr. Carus, and supplementary materials for the study of Kant's life and philosophy, consisting of estimates of different phases of Kant's philosophy by Windleband, Weber, Schwegler, Lange and others. An exceedingly valuable book, enabling us to grip the essentials of Kant's philosophy. Dr. Carus has rendered a great service to English students of Kant in this book.

Leibniz Discourse on Metaphysics, Correspondence with Arnauld, Monadology. Translated from the originals by Dr. George R. Montgomery. Published by the Open Court Publishing Co., Chicago, Nov.–Dec., 1901.

Dr. Montgomery, by translating these parts of Leibniz's works, has enabled the English student of philosophy unable to read French, to study the Leibnizian philosophy from the genetic standpoint, thereby enabling him to grasp the true significance of the monadology through a study of his earlier writings. The translations are exceedingly well done, and the introduction by Paul Janet illuminates the pages following.

A Scientific Philosophy the Harbinger of a Scientific Theory; or, Steps to Philosophical and Theological Unity. Swan Sonnenschein and Co., London, 1901. pp. 241.

The writer's effort is to show that the old Scottish philosophy of common sense which proclaims an objective reality can be satisfactorily established on scientific principles; and secondly and chiefly, that the doctrines of Holy Scripture, duly interpreted, can be made to rest on and be consistent with the self same principles. Causality is the test of science. With this end in view, God, sonship, the origin and removal of sin, the soul, freedom, causality, election and predestination, priesthood, and the Lord's Supper are discussed.

A Primer of The Christian Religion. Based on the Teaching of Jesus, Its Founder and Living Lord, by GEORGE H. GILBERT. The Macmillan Co., New York, 1902. pp. 76.

This primer, we are told, and the whole Gospel is a primer, seeks only to turn the reader's thoughts to the great events and to the main features of the life and teachings of Jesus. It speaks the language of the school, and treats of Jesus, God, spirit, the kingdom of God, following Jesus, the Bible Sunday and the hereafter. The whole is put in eighty-five questions printed in red, each with a concise answer, evidently for memorization, with a few proof texts and generally a note.

The Menopause, by ANDREW F. CURRIER. D. Appleton and Co., New York, 1897. pp. 309.

Although this work is not exactly new, it is so excellent and compendious and so supersedes Tilt's well known book upon the same subject, that it deserves brief mention.

Die Entwicklung der Religionsbegriffe als Grundlage einer progressiven Religion, von STEFAN von CZOBEL. Lotus-Verlag, Leipzig, 1901.

This is the last half volume of a work briefly characterized in a former number of this *Journal.* This is devoted to morals, external cult and priesthood.

Der Gesang der Vögel, seine anatomischen und biologischen Grundlagen, von VALENTIN HAECKER. Gustav Fischer, Jena, 1900. pp. 102.

In this interesting and important work, the writer treats first of the structure of the vocal organs of birds. He then discusses at lengt sexual dimorphism. Most interesting, perhaps, is the third chapte on the development of the singing instinct in its various forms. H then treats other courtship phenomena—drumming, tumbling, playing, mock fighting, etc. Finally, he discusses the development an significance of the courting instinct and the relations between reflexes instinct and play, and ends with a good nomenclature.

Les Arts et Métiers chez les Animaux, par H. COUPIN. Nony & Cie Paris, 1902. pp. 422.

This ingenious and industrious writer has collected from many sources accounts of the industries of animals, which he classifies as masons, potters, weavers, paper makers, cotton makers, mound builders, road and bridge makers, sewers, wax moulders, rosin makers, tapisers, miners, basket makers, wheel makers, confectioners, cigar makers, hammock makers, comb makers, spinners, architects of houses of amusement, carpenters, hut builders, ditch makers, stone borers, etc.

La Logique chez l' Enfant et sa Culture, par FRÉDÉRIC QUEYRAT. F. Alcan, Paris, 1902. pp. 157.

This naturally follows the two earlier works of the author on "Imagination and its varieties in children" and "Abstraction and its rôle in education." First comes the logic of images with examples seen in their comparisons and the construction of phrases and propositions, personification and anthropomorphism. Analogical reasoning is thus the first type. Child sophisms are classified under induction (mainly those of insufficient data, errors concerning causes and sophisms of accidence) and deduction or a begging question, and ignorance of the subject and vicious circle. The chief faults of children might be characterized as due to credulity, candor, naïveté, folly, precipitation, prejudgment, irreflection, sentiment and imagination. The last chapter praises the importance of rational training.

Der Selbstmord im kindlichen Lebensalter, von A. BAER. G. Thieme, Leipzig, 1901. pp. 84.

A member of the council of public hygiene in Berlin here ably sums up the history of the statistics of suicide of youth in France, Italy, and especially Germany, and draws therefrom important lessons. He holds that the chief cause is not to be found in the school, although he would relieve it from over pressure and especially from the worry of examinations, to which some cases especially in the lower schools can be directly traced. The chief cause to him is precocity or the premature development of an adult sense of responsibility, altruism or knowledge, and finds it most frequent in the lowest and in the highest stages of society, or better among the poorest and the richest strata of society. Of twenty-five interesting cases, he has himself made a special study. It is extremely desirable to have data on this subject collected with the same care for Anglo-Saxon races.

The Four Temperaments in Children. Their Appearance and Treatment in Rearing and in the School. As Appendix: The Temperament of Parents and Teachers. By BERNHARD HELLWIG. J. Esser, Paderborn. pp. 79.

This is an interesting characterization of each of the four phrenological types of childhood—the sanguine, choleric, melancholic, and phlegmatic. The treatment proper to each type is considered, and there is an appendix on the temperament of parents and teachers. Whatever we may think of phrenology, this book is of much interest and value.

Mental Growth and Control, by NATHAN OPPENHEIM. The Macmillan Co., New York, 1902. pp. 296.

The writer discusses in successive chapters the growth of character; nind as a machine; the power of attention; what association means; the ses of instinct; memory and its development; the bonds of habit; hypotism and suggestion; imagination, the enlightener; the emotions and heir education; reasoning, the guide; will, the controller.

.es Caractères, par FR. PAULHAN. F. Alcan, Paris, 1902. pp. 247.

The author here shows the different manifestations which abstract aws produce in different psychic types. His conception is new and ersonal, and he holds that the study of forms of character is attached o abstract psychology. He undertakes to classify individual types. 'he first edition of this work was long since exhausted, and here variius objections are met.

Einleitung in die theoretische Biologie, von J. REINKE. G. Paetel, Berlin, 1901. pp. 638.

In the first section, the author treats of the relations between biolo:y and philosophy; in the second, he discusses necessity in biological :vents; in the third, the forces and laws that work in organisms; then lementary organisms, heredity, and voluntarism and the mechanicosychic view of life.

The Primitive Family in Its Origin and Development, by C. N. STARCKE. D. Appleton and Co., New York, 1901. pp. 315.

The writer treats at great length the definition of kinship among primitive people in Australia, America, Africa, Asia, Polynesia, and imong the Aryans. He then addresses himself to his theme, and treats 'ather and child, polyandry, the levirate and the niyoga, inheritance y brothers, nomenclatures, exogamy, endogamy, marriage and its levelopment, family, tribe and clan.

Some First Steps in Human Progress, by FREDERICK STARR. Chautauqua Assembly, New York, 1901. pp. 263.

This tasteful little book is amplified from Chautauqua lectures and reats fire making, food getting, basket and pottery, hunting, the cul:ivation of plants, domestication, man of the stone age, metal working, weapons, dress and ornament, houses, boats, carts and sledges, ges:ure and speech, writing, tales and traditions, marriage and family, eligion, the dead man, custom and law.

Nouvelles Observations sur un Cas de Somnambulisme avec Glossolalie, par TH. FLOURNOY. Ch. Eggiman et Cie, Genève, 1902. pp. 255.

The author here collects phenomena from Miss Smith after the pubication of "Des Indes," and discusses the astronomic and oriental :ycles and makes important inferences concerning the supernormal.

A Complete Exposé of Eddyism, or Christian Science and the Plain Truth in Plain Terms Regarding Mary Baker G. Eddy, Founder of Christian Science, by FREDERICK W. PEABODY. An address delivered at Tremont Temple, Boston, August 1, 1901. pp. 68.

The author was the counsel in a recent widely reported trial involving the principles of Christian Science. He deserves great credit, both for his fearlessness, for the vigor of his investigations, and for printing this very frank and lucid book, which all interested in the subject should read.

Lewis G. Janes: Philosopher, Patriot, Lover of Man. James H. West Co., Boston, 1902. pp. 215.

These papers by one of the leading modern free thinkers, dedicated to the author's known and unknown friends, are grouped under the following leading heads: tributes by the Greenacre School, by the Cambridge Conference, by the Brooklyn Ethical Association, the Free Religious Association, and letters and other tributes. A list of his writings is appended, and there are five illustrations.

L'Occultisme et le Spiritualisme, par G. ENCAUSSE. F. Alcan, Paris, 1902. pp. 188.

After treating the psychology of occultism, astral body, consciousness, etc., the writer discusses its logical method and the relations of the soul to the microcosm or universe. Then follow the metaphysics, morals, traditions, sociology, etc., of occultism.

A Syllabus of Psychology, by H. HEATH BAWDEN. Vassar College, Poughkeepsie, N. Y., 1902. pp. 109.

This little manual endeavors to utilize the results of experimental and genetic methods, but the writer is principally interested in the larger aspects of the problem. To our thinking, the author has not escaped the danger of all abbreviated treatments and is somewhat too abstract for pupils of the age intended. The genetic aspect is very inadequately treated, and there is no evidence in the volume that the author is familiar with its literature.

Ophthalmic Myology, a Systematic Treatise on the Ocular Muscles, by G. C. SAVAGE. Gospel Advocate Publishing Co., Nashville, Tenn., 1902. pp. 589.

This compendious work, with sixty-one illustrative cuts and six plates, opens with a chapter on the fundamental principles of ocular motions, which will interest every working psychologist. It states in terms, often new and always clear, the law governing the recti and the obliques, innervations, the law of rotation to vertical and horizontal fixed planes of the head, the law of corresponding retinal points, the law of direction to individual muscle and its plane of rotation, with suggestive figures.

Die Welt als That, von J. REINKE. G. Paetel, Berlin, 1901. pp. 504.

The author first discusses the subject and the object of the investigation of nature; then the world stage, including sun, moon, history of life, force and matter; the essence of life; growth, irritability, propagation, adaptation and intelligence; Darwinism, including Weismann and Nägeli; and the relations of natural science to the God idea.

Études Esthétiques, par GEORGES LECHALAS. F. Alcan, Paris, 1902. pp. 306.

In the introduction, the writer treats of the beautiful and the ugly; and then in successive chapters passes to the discussion of what is art, its relations to nature, to mathematics, the role of suggestion in art, the affinities and associations to different arts, its relation to curiosity and to morals.

Typical Modern Conceptions of God or the Absolute of German Romantic Idealism and of English Evolutionary Agnosticism, with a Constructive Essay, by JOSEPH A. LEIGHTON. Longmans, Green and Co., New York, 1901. pp. 190.

This work originated in a Cornell thesis seven years ago. The original paper dealt only with Fichte and Hegel. Here Schleiermacher and Spencer are added. Each have a chapter, and in the fifth the author sums up his own conclusions. The absolute is the experienced unity of will and thought.

THE AMERICAN
JOURNAL OF PSYCHOLOGY

Founded by G. STANLEY HALL in 1887.

Vol. XIII. JULY, 1902. No. 3.

A PRELIMINARY STUDY OF THE EMOTION OF LOVE BETWEEN THE SEXES.[1]

By SANFORD BELL, Fellow in Clark University.

The emotion of love between the sexes has as yet received no thorough scientific treatment. No writer so far as I can find has treated it from a genetic standpoint. The literature upon the subject is therefore meager. In his recent treatise upon "The Psychology of the Emotions," Ribot[2] remarks: "The sex-instinct, the last in chronological order with man and the higher animals, gives rise to the emotion of love with its numerous individual varieties. Most psychologists have been very sparing of details where it is concerned, and one might mention certain voluminous treatises which contain no mention of it. Is this through exaggerated delicacy? Or is it because the authors think that their place has been usurped by the novelists who have so obstinately confined themselves to the study of this passion? But the novelist's mode of analysis is different from the psychological mode, and does not exclude it." This author then devotes one chapter of eleven pages to the treatment of the sexual instinct, which includes what he has to say upon sex-love. Brief as this treatment is, it is valuable, both for the facts it presents and for the problems it suggests. Havelock Ellis, who has perhaps done more than any other investigator in the field of the normal Psychology of Sex says in his most recent work:[1] "It is a very remarkable fact that although for many years past serious attempts have been made to elucidate the psychology of sexual perversions, little or no endeavor has been made to study the psychologic development of the normal sexual emotions. Nearly every writer seems either to take for granted that he and his readers are so familiar with all the facts of normal sex psychology that any detailed statement is altogether uncalled for, or else he is content to write a few introductory phrases, mostly made up from anatomic, philosophic and historical work.

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[1] It should be borne in mind by the reader that this article is a preliminary study. It forms a part of one chapter of a relatively comprehensive study of some of the aspects of the Psychology of Sex. The writer appreciates the fact that there may be a number of questions suggested to the reader, the satisfactory answer to which cannot be found in the data submitted here. It may also seem that too much is made of some of the facts and that certain interpretations are unwarranted. This effect is almost always inevitably the result of isolating any phase of a subject from its settings in the whole to which it belongs. Several points merely touched upon in this article are to be exhaustively treated in other sections of the same study.

[2] Ribot: The Psychology of the Emotions, p. 248.

Yet it is unreasonable to take normal phenomena for granted here as in any other region of medicine. A knowledge of such phenomena is as necessary here as physiology is to pathology or anatomy to surgery. So far from the facts of normal sex development, sex emotions and sex needs being uniform and constant, as is assumed by those who consider their discussion unnecessary, the range of variation within fairly normal limits is immense, and it is impossible to meet with two individuals whose records are nearly identical.

There are two fundamental reasons why the endeavor should be made to obtain a broad basis of clear information on the subject. In the first place, the normal phenomena give the key to the abnormal, and the majority of sexual perversions, including even those that are most repulsive, are but exaggerations of instincts and emotions that are germinal in normal human beings. In the second place, what is normal cannot be determined until the sexual life of a large number of healthy individuals is known, and until the limits of normal sexuality are known the physician is not in a position to lay down any reasonable rules of sexual hygiene."

Although very short, the analysis of the sex passions in adults by Herbert Spencer[2] in a part of one section in his "Principles of Psychology," is one of the best. Bain[3] devotes one chapter to the Tender Emotion which he makes include Sex-love, the parental feelings, the benevolent affection, gratitude, sorrow, admiration and esteem. A very few pages are given to sex-love proper. Very suggestive paragraphs bearing either directly or indirectly upon the subject are to be found in the works of such writers as Moll, Sergi, Mantegazza, James, Janet, Delboeuf, Feré, Boveri, Kiernan, Hartmann, Dessoir, Fincke and others. There is a vast amount of literature upon the pathological phases of the subject which is to be considered in another chapter.

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[1] Psychology of Sex, Vol. III; Alienist and Neurologist, July, 1901, p. 500; American Journal of Dermatology, Sept., 1901.

[2] Principles of Psychology, Vol. I, pp. 487, 488.

[3] The Emotions and the Will, Chap. VII.

The analyses thus far given by scientists are limited to the emotion as it is manifested in the adult. A few writers have referred to it in dealing with the psychology of adolescence, but in this connection refer to it as one of the many ways in which the adolescent spirit shows its intensity, turbulence and capriciousness. I know of no scientist who has given a careful analysis of the emotion as it is seen in the adolescent. It is true that it has been the chosen theme of the poet, romancer and novelist. But in the products of such writers we may look for artistic descriptions of the emotion and for scenes and incidents that very truly portray its nature; we have no right to expect a scientific analysis.

Adults need only to recall their own youth or to observe even briefly our grammar and high school boys and girls, to be convinced that love between the sexes is one of the emotions that become conspicuously apparent in early adolescence. This is what might reasonably be expected since the emotion is derived from the sex instinct, and pubescence marks the period of rapid acceleration in the growth of the sex organs. With the increase in size and vigor of the reproductive organs there comes the strong impulse for the organs to function. Before civilization developed the system of sex inhibitions that are considered an essential part of the ethical habits of our young people, the impulse to function was not repressed and pubescence marked the beginning of the distinctively sexual experience of both sexes. This was true of primitive peoples, and is generally true of the lower races that are living to-day. It is, however, not limited to these races. A very large percentage of both sexes of the civilized races begin their sexual life during early adolescence. This is particularly true of the male half of the races. The system of sex inhibitions which has gradually been developed by civilization has been along the line of evolution and has been doing away with promiscuity, polygamy and polyandry; it has been establishing monogamy and postponing marriage until a period of greater physiological and psychological maturity of both sexes. This same inhibition of early sex functioning has lead to an increase in the prevalence of such substitutes as masturbation, onanism, pederasty, etc. Such facts bear upon the physiological results of inhibition. On the psychological side are to be mentioned courtship and those sex irradiations that have so profoundly influenced art, literature, religion, polite society, sports and in-

dustry. Many of the pathological sex psychoses, such
for the same sex, erotopathia, sexual anæsthesia, etc.,
be explained, at least in part, by reference to the res
these social inhibitions trying to establish themselves.

The emotion of sex-love, so plainly traceable to the
ductive instinct, has its evolution in each normal indi
It develops through various stages as do other instinc
does not make its appearance for the first time at the pe
adolescence, as has been thought. Extended and vari
perience in the public schools has furnished me with ve
orable opportunities for making observations upon c
who were allowed to mix freely regardless of sex. Mos
observations were made in schools which, with very f
ceptions, had outdoor recesses during which the pla
games brought both sexes together under no restrain
than the ordinary social ones with perhaps some modifi
by the particular regimen of the school concerned. The
vations relative to the subject of love between the sex
begun fifteen years ago. The first observations were m
cidentally and consisted mainly of those love affairs b
children, that needed my attention as one officially con
However, many were unquestionably innocent and ha
My observations have not been limited to children under
conditions. About one-third of the number of cases w
have personally observed have been concerning childr
were under the ordinary social or industrial conditions.
ing the past fifteen years, from time to time, I have co
as many as eight hundred cases observed by myself. In
tion to these I have seventeen hundred cases as returns
syllabus which I circulated among the students in my
gogy and psychology classes at the Northern Indiana
School, at Valparaiso, Ind., in 1896. The syllabus is
lows:

I. *Love between children of about the same age and o*
site sex. Give as completely as you can the details of an
cases you know of; age of each child; length of time th
continued; whether it was mutual; what broke it up; an
of jealousy; any *expressions* of love such as confessions, ca
gifts, etc.; any ideas of marriage; actions in presence o
other free or shy, when alone, when in the presence of
any tendency of either child to withhold demonstrations
satisfied to love at a distance; any other details you ma
noticed.

II. *Love between children and those of opposite sex w*
much older. Give complete details on such points as in
in I, with whatever differences the disparity in age woul
urally make.

III. Give fully, frankly, and as accurately as you can the details of your own childish love affairs.

IV. Give your name (this may be left blank), age, and sex.

360 people reported more than 1,700 cases. With few exceptions those who reported had had experience in teaching. 355 gave accounts of their own childish love affairs. The other five stated that they did not recall any such experience in their own lives. The 1,700 cases include the confessions. Added to the 800 cases of my own collection there are in all more than 2,500 cases that form the basis of this study.

It will be seen that the syllabus calls for data of three kinds, viz., concerning (1) observed love between children of opposite sex about the same in age, (2) observed love between persons of opposite sex with disparity in ages, (3) personal confessions. The first two kinds of data were obtained by the objective method, while the last is obtained through retrospection. Having both observations and confessions many errors that could not otherwise be detected are eliminated since the two classes of material act, to a degree, as mutual controls. Each kind of data according to the first named classification has its particular virtue. The confessions (1) exhibit the continuity in the development of the emotion during the life-span of the individual as he sees it himself (enough cases (355) were given to make a reasonable allowance for individual variations); (2) they indicate the general prevalence of the emotion during childhood; (3) they reinforce observation in the same way that introspection always reinforces the objective method of study. In estimating the value of these confessions one must be mindful of the common defect of most auto-biographical statements, viz., that they are influenced by the almost irresistible tendency to write about one's self in a literary way and so touch plain facts as to make them less prosaic. The observations help us in eliminating this element of error. The data concerning the love that children have for adults of the opposite sex throw valuable light upon the nature of jealousy in children as it is much accentuated in these cases. They also show the effect of forcing the development of an emotion by a stimulus that is chronologically prior to the normal period of development. In the cases showing the love of the adult for a child are revealed facts bearing upon some forms of sexual perversion. In these cases the child is used as a means of escape for suppressed love. Love that normally should go out to an adult, is through some real or supposed necessity suppressed until it finally seeks quiescence through discharge upon a child or pet animal. This is not infrequent among women whose relatively passive role decreed by nature in love affairs has been exaggerated by society. The observations concerning love between children of opposite sex and about the same age aid us in determining the phase of the emotion's development that normally belongs to any given period of life; *i. e.*, there are many observations upon children who are five years old, or six, seven, eight, nine, etc., respectively, and these reveal the nature of the emotion that normally belongs to those years. The various kinds of observations extend over the entire periods of infancy, childhood, and into adolescence, and are very well distributed in number among the years of these periods, although more cases were reported for the years 4 to 8, and 12 to 15, both inclusive, than for the years of the period between 8 and 12. The reason for this becomes clearly apparent later.

Analysis of the data contained in all of this material reveals the fact that the emotion of sex-love may appear in the life of the child as early as the middle of the third year. From its appearance at this early age it can be traced in its development through five more or less well marked stages whose time limits are as follows: the first stage extending, as a rule, from the age of three years to the age of eight years; the second from eight to fourteen; the third from fourteen to maturity at about twenty-two in women and twenty-six in men; the fourth from maturity to senescence, whose limits vary widely; the fifth extending through senescence. Not every individual passes through all five stages. Individual differences also keep the time limits of the stages from being exact.

CHARACTERISTICS OF THE FIRST STAGE.

The presence of the emotion in children between three and eight years of age is shown by such action as the following: hugging, kissing, lifting each other, scuffling, sitting close to each other; confessions to each other and to others, talking about each other when apart; seeking each other and excluding others, grief at being separated; giving of gifts, extending courtesies to each other that are withheld from others, making sacrifices such as giving up desired things or foregoing pleasures; jealousies, etc. The unprejudiced mind in observing these manifestations in hundreds of couples of children cannot escape referring them to sex origin. The most exacting mind is satisfied when to these observations are added the confessions of those who have, as children, experienced the emotion to a marked degree of intensity, and whose memories of childhood are relatively distinct. We are prone to refer many of the manifestations enumerated to imitation. Imitation can account in part for the *form* in which the emotion shows itself, whose *presence* is established by the accumulation of a vast amount of evidence. Imitation plays an important role in the development of the sex instinct, and love between the sexes as one of this instinct's derivatives, as it does with the development of most other instincts. It would be no more satisfactory to account for these manifestations by referring them to imitation than it would to account for the love for dolls, the instinct of hunting, the interest in "playing house" by reference to the same cause. When we observe in young puppies, shoats, squirrels, seals, grouse, partridges, field-sparrows, starlings, wood-larks, water-wagtails, goldfinches, etc., actions corresponding to these which I have mentioned in children, we have no hesitancy in referring them to the sex instinct for explanation.

So far as the observations given to me by others are concerned, with very few exceptions, they all report hugging, kissing and other means of affecting physical contact, as being indulged in by the child lovers. This is largely due to the fact that the observers took these actions as the main ones that indicate the presence of the emotion and reported no cases in which they did not occur. My own observations and some of the confessions show that although some form of embrace is general, it is not always present. Through all of the stages of the emotion's development the embrace in some of its forms is the most general means of its expression. A quotation from Groos[1] in this connection is deemed appropriate. In speaking of natural courtship he says: "But a scientific system of natural courtship of the various human races does not exist; nor, indeed, have we systematic observations of any one people. It is, therefore, impossible to affirm whether there are such things as instinctive gestures, expressions, caresses, etc., which all human beings recognize as sexual stimuli. From the little that is known it seems probable that the number of such tokens is not great,—even the kiss is by no means general! We can only be sure of a universal tendency to approach and to touch one another, and of a disposition to self exhibition and coquetry as probably instinctive and of the special forms which these tendencies take under the influence of imitation and tradition as secondary causes. Caressing contact may then be regarded as play when it is an end in itself, which is possible under two conditions. First, when the pursuance of the instinctive movements to their legitimate end is prevented by incapacity or ignorance; and, second, when it is prevented by an act of the will on part of the participants. Children exhibit the first case, adults often enough the second. It is generally known that children are frequently very early susceptible to sexual excitement, and show a desire for contact with others as well as an enjoyment of it, without having the least suspicion of its meaning." In the cases in which I have recorded lifting each other as indicating sex-love, it was unmistakably apparent that the lifting was not a trial of strength but an indulgence in the pleasures of bodily contact, as was also true of the scuffling. In few, if in any of the cases which I have observed upon children of eight, have the participants been conscious of the meaning of their actions, although I have sometimes seen them attended by great sexual excitement. Schaeffer[1] believes that "the fundamental impulse of sexual life for the utmost intensive and extensive contact, with a more or less clearly defined idea of conquest underlying it," plays a conspicuous part in the ring fighting of belligerent boys. Bain[2] attaches very great importance to the element of physical contact in sex-love. He says: "In considering the genesis of tender emotion, in any or all of its modes, I am inclined to put great stress upon the sensation of animal contact, or the pleasure of the embrace, a circumstance not adverted to by Mr. Spencer. Many facts may be adduced as showing this to be a very intense susceptibility, as well as a starting point of associations. (1) Touch is the fundamental and generic sense, the first born of sensibility, from which, in the view of evolution, all others take their rise. (2) Even after the remaining senses are differentiated, the primary sense continues to be a leading susceptibility of the mind. The soft, warm touch, if not a first-class influence, is at least an approach to that. The combined power of soft contact and warmth amounts to a considerable pitch of massive pleasure; while there may be subtle influences not reducible to these two heads, such as we term, from not knowing anything about them, magnetic or electric. The sort of thrill from taking a baby in arms is something beyond mere warm touch; and it may rise to the ecstatic height, in which case, however, there may be concurring sensations and ideas. Between male and female the sexual appetite is aroused. A predisposed affection through other means, makes the contact thrilling. (3) The strong fact that cannot be explained away is, that under tender feeling there is a craving for the embrace. Between the sexes there is the deeper appetite; while in mere tender emotion, not sexual, there is nothing but the sense of touch to gratify unless we assume the occult magnetic influences. As anger is consummated, reaches a satisfactory term, by knocking some one down, love is completed and satisfied with an embrace. This would seem to show that the love emotion, while fed by sights and sounds, and even by odors, reaches its climax in touch; and, if so, it must be more completely identified with this sensibility than with any other. In a word, our love pleasures begin and end in sensual contact. Touch is both the alpha and omega of affection. As the terminal and satisfying sensation, the *ne plus ultra*, it must be a pleasure of the highest degree." While it is the contact through the sense of touch that acts both as the most natural and most complete expression of love between the sexes and a powerful sexual excitant, there is a contact of the eyes of adolescent and adult lovers,—a sort of embrace by means of the eyes—that is as exciting to many as contact through touch.

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[1] The Play of Man, p. 254. New York, 1901.

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[1] Zeitschr. f. Psychol. u. Physiol. d. Sinnesorgane, Vol. II (1891), p. 128. (Quoted by Groos.)

[2] The Emotions and the Will, pp. 126, 127.

The pleasure derived from hugging and kissing, etc., in children who have the emotion in this first stage of its development, is not specifically sexual except in some cases which I am inclined to consider as precocious. Normally, there appears to be no erethism of the sexual organs during the process of love-making. But erethism, as we shall see in another chapter upon the analysis of the sex impulse, is not confined to the sexual organs, but is distributed throughout the entire body, especially through the vascular and nervous systems. In these children there is a state of exaltation, indeed as yet not comparable in intensity to that of the adolescent or adult, which is, nevertheless, erethistic in its nature. It is massive, vague, and generally distributed throughout the body. In some cases there is specific sexual excitement with erections of the penis and hyperæmia of the female genitalia. Such phenomena are seen only in the cases that seem to me to be precocious. This point will be more fully treated in the chapter referred to above. Suffice it to say here that in love between the sexes at this early period or in the next following, the physical sensations of sexual excitement are generally wholly wanting, or if present are entirely unlocated. Love between children of the opposite sex bears much the same relation to that between adults as the flower does to the fruit, and has about as little of physical sexuality in it as an apple-blossom has of the apple that develops from it.

The love demonstrations of children in the first stage of the emotion's development are generally spontaneous, profuse, and unrestrained. There is an absence of shyness, of any sense of shame, of the feeling of self-consciousness. The children have as yet no notion of the meaning of sex. Their naïvete in this regard has not been destroyed by the social suggestion that such actions are wrong and vulgar. They are natively happy and free in their ignorance. The individual differences among children are as great in their experiencing and manifesting this emotion as they are in any other phase of life, so not infrequently we find children under eight years of age who are shy, repressive and self-conscious in regard to their love actions. The same children are shy and repressive in other things. It is more of a general disposition than a specific attitude toward this one emotion.

The giving of gifts and the sharing of choice possessions is very common. The emotion in its earliest form introduces the element of self-sacrifice for the loved one that is inseparable from the emotion in all of its normal stages of development. It likewise introduces the intense selfishness that comes from the desire to monopolize the allegiance of the one loved. An only child, who as a rule is very selfish and will not share any of his possessions with others, readily gives up a liberal part to the lover. During the earlier years of this stage the gift is appreciated for its inherent value; it is good to eat, or pretty to look at, or has some other real value. This inherent value continues to be an element of appreciation in lovers's gifts throughout life. It is given by the lover as an expression of his love, and so received and prized by the sweetheart. Everything else being equal, the greater the real value the more satisfactory is the love expression to both. In the 6th and 7th years there appears unmistakable evidence of acquired value in the presents. They become of value because the lover gave them and, on account of their associations, are preserved as keepsakes. As early as the 6th and 7th years presents are taken from their places of safe keeping or where they are on exhibition as ornaments, and kissed and fondled as expressions of love for the absent giver. This is interesting as evidence of love-fetichism appearing in early childhood.

The emotion otherwise affects the moods and disposition of children. Refractory children, whose parents manage them with difficulty, become docile and amiable under the influence of the sweetheart or lover. Boys who, at other times, are cowards will fight with vigor and courage when their love is concerned. Children that have a sociable disposition sometimes become exclusive and abandon all other playmates for the chosen one, and cannot be induced to play with any one else. Ideas of marriage are often present, but they are vague and are present through social suggestion. The general attitude is represented by the testimony of one woman who stated that she had no definite idea of marriage at the time of her earliest childish love affair, but that she had a vague feeling that she and her little lover would always be together, and this feeling was a source of pleasure. Certainly children under eight have little foresight; they are chiefly absorbed in the present whose engrossing emotions give no premonition that they will ever change.

Beauty begins to be a factor in the choice of a sweetheart among the children in this first stage. The most beautiful, charming, and attractive little girls are the ones who are favored. This element becomes much more conspicuous in the later stages. Jealousy is present from the first. It is more pronounced in the cases of love between children and adults of the opposite sex on account of the child's being less able to monopolize the attention of the adult and on account of the precocity of the child concerned in such cases. A fuller discussion of jealousy belongs in another section of this study.

TYPICAL CASES.

Case 1. Boy 3, girl 5. Love is mutual. When in a large company of children they will always separate themselves from the others and play together. Never tire of telling each other of their love. Delight in kissing and embracing, and do not care who sees them.

Case 2. B. 5, g. 4. Began at ages given and still continues, two years having gone. Are often seen hand-in-hand; are very jealous of each other. Boy more backward than girl. Will not play with other children when they can be together.

Case 3. B. 3, g. 3½. Have been deeply in love since their third week in kindergarten. Rose not so jealous as Russel. She always watches for his coming, and runs to meet him the moment he enters the room. They sit together at the table and in the circle, and cry if separated. They are very free and unrestrained in showing their love by kissing, hugging, and by many little attentions.

Case 4. B. 3, g. 3. My little nephew of three and a little neighbor girl of the same age had a most affectionate love for each other, and were not at all shy about it. They would kiss each other when they met, and seemed to think it all right. The little boy used to tell me that they would marry when grown. This continued about two 'and a half years; then the girl's parents moved away, much to the grief of both children. The little boy would often climb up and take the girl's photograph from the mantle and kiss it.

Case 5. B. 3, g. 3. My nephew of three manifested an ardent passion for a small girl of about the same age. He followed her about with dog-like persistence. Being an only child he was very selfish, never sharing anything with other children. But Bessie became the recipient of all his playthings. His hoard of treasures was laid at her feet. Nothing was good enough for her, nor could he be dressed fine enough when she was around. On one occasion, a large boy picked Bessie up to fondle her, whereupon her jealous lover seized a hatchet and attacked his rival. He imperiously demanded a dollar from me one day in order that he might buy Bessie and have her 'all for his own.' He is now six, and loves her as much as ever.

Case 6. I know of two young people who have been lovers since babyhood. As they grew up their love for each other assumed different aspects. During the first seven years of their lives their love was open and frank, showing no restriction of the regard they felt. Caresses and embraces were indulged in as freely and unrestrictedly as might have been between two little girls. But when school life began and they became exposed to the twits and teasings of their playmates there developed a shy timidity and reserve when in the presence of others. Though they have been separated for long periods at different times their love has continued.

Case 7. Both about five years old when they first showed signs of love that I observed. May have begun earlier. Lasted four years.

Broken up by girl's parents moving away. Love was mutual without any signs of jealousy that I could see. Exchanged gifts, such as candy, nuts, flowers, etc. Their actions at first very free either when alone or in the presence of others. Later they became somewhat shy in the presence of others, but free when alone. Upon the girl's moving away the boy showed very deep feeling of sorrow. Do not know about the girl.

Case 8. My little brother at the age of four was very much in love with a little girl two years of age. He used to lead the little girl around, caress her tenderly, and talk lovingly to her. He always divided with her the playthings he most appreciated. He often said he expected to marry her. While the little girl did not object to his demonstrations, she seemed to care more for a young man thirty-three years of age, and called him her sweetheart. The little boy became jealous, and finally gave her up. After they entered school together the little girl became very fond of my brother, and always managed to sit or stand next to him in the class if possible, but he had lost all interest in her, and never cared for her again.

Case 9. B. 6, g. 5. They had been lovers for about two years. They did not get to be together often since they lived in different towns. Their families were relatives and exchanged visits. Upon one occasion when of the age indicated above they met at the home of Jeaness's grandfather. Edgar came late. Jeaness was seated upon a hassock in the parlor where there were several guests. Upon Edgar's entering the door, she saw him and, as her little face beamed with evident delight, she arose and met him in the middle of the room. They were immediately in each others arms. Edgar's mother, seeing the vigor with which he was hugging Jeaness, said to him with concern: "Why, Edgar, you will hurt Jeaness." Jeaness, who evidently was better able to judge, archly turned her head and with a smile that meant much, said: "No, he won't."

Case 10. B. 2, g. 2. One afternoon last summer two of my little cousins, Florence twenty-three months old and Harold two years old, were spending the day at my home. They had never met until that day. Florence is an only child and is inclined to have her own way, and is n't willing to give up to other children. Harold has rather a sunny disposition. They had not been with each other more than an hour before they were sitting on the porch and Florence had her arms around Harold. She was very willing to give up to him and share all she had. They played together the remainder of the day, and were very affectionate. Ever since then they have been very devoted to each other, and it is very beautiful to watch them in all their little ways of indicating their love for each other.

Case 11. I attended a wedding last June which was the outcome of a striking illustration of this love. I will tell the story as the bride's mother told it to me. "This does not seem like a marriage to me but just one more step in a friendship which began when Minnie and Theo were babies. Before either could walk they would sit on the floor and play with each other—never having any trouble over playthings, but sharing everything alike. Theo would break bits of cake and put in Minnie's mouth, and then both would laugh as though it were a great joke. If they were separated both would cry. As they grew up the friendship grew stronger, and Theo always called Minnie his 'little wife.' At school they were always lovers, and when we moved here it was understood that when Minnie was twenty-one Theo should come for her. During their entire lives I do not know of a single quarrel between them."

Case 12. One bright morning I noticed a little boy sitting in front of me who had not been there before. He turned around occasionally to look at me, and presently smiled. Of course I returned the smile, thinking that he was the sweetest little fellow that I had ever seen. This was the beginning of a love that lasted for several years. He was six, and I was the same age. On the next day he brought me a pretty picture, and after that paid so much attention to me that he was soon acknowledged to be my lover. Neither of us was the least bit shy over it. He did not care to play with the other boys and I did not care to play with the girls. We were not contented unless we were together. He freely confessed his love to me and confided all of his joys and sorrows in me. For three years and more he seemed to care as much for me as I did for him. When he came to our home to play with my brothers he usually forgot them and played with me. At dinner mamma always seated us side-by-side. We planned our marriage; his father who was a minister was to perform the ceremony. We discussed wedding dresses, bridesmaids and breakfasts with great seriousness. One day,—the fatal one to my childish happiness, a new girl came to school. I could not help noticing how often his eyes turned from me to her, and feared a rival from the first. He wanted her to play with us, and although I far rather would have preferred being alone with him, I hid my feelings and asked her. I tried to treat her kindly because I knew that it would please him. One day he asked me with great hesitation if I objected to his having two sweethearts. I smothered my jealous feelings and replied that I did not if he would marry *me*. He told me that he would, that he loved me,—in a way that was a compensation for my sacrifice. For some time the other girl and I got along very well as sister sweethearts; but I soon saw that she was receiving all of the caresses, and I concluded that I would not have it so. We had an interview. He said that he still loved me, but he gave me plainly to understand that he would be pleased to have me withdraw. Of course I did so, but was determined never to let either of them know that I cared. After a time they grew tired of each other, and he came to ask my forgiveness and make up, but by that time I had an older and as I thought better sweetheart; so he was left to repent his rash action while sweetheart number two captured some one else more suited to her taste.

CHARACTERISTICS OF THE SECOND STAGE.

The second stage in the development of the emotion of sex-love extends in time from the eighth year to about the twelfth year in girls and to the fourteenth year in boys. It is characterized by the appearance of shyness, of modesty, especially in girls, of self-consciousness and consequent efforts toward self-repression; by the inhibition of the spontaneous, impulsive love-demonstrations so freely indulged in during the previous stage. The boys are more secretive than the girls, but the tendency to conceal the love is present in both. This is the reason why fewer returns came for the years eight to twelve than for the years before and after this period. The children were to a degree successful in hiding their love and so passed unobserved. To the observer who does not depend upon the more demonstrative signs but who sees the less obvious but equally indicative ones, the emotion is easily detected. There is a conspicuous absence of pairing. The lover and sweetheart are not often seen alone together. On the other hand, they are much confused and embarrassed when circumstances do bring them into each other's presence. Mutual confessions are seldom made,—at least, not directly, face to face. Some confess to friends, but this is usually done very reluctantly. Some confess through notes delivered by friends, or passed in some secret way; some reveal it by defending the sweetheart when she is being "talked about," in many of which cases boys fight most spiritedly for the honor of the one they love. Some never confess,—neither to friends nor to lover. Some boys deny that they are in love and speak slightingly about their sweetheart, but afterwards confess. Then there are the revelations through gifts that are nearly always delivered in some secret manner, in many instances of which the giver leaves no clue that would reveal his identity; in other instances cards or notes are left, but it is rare to find lovers in this stage giving gifts face to face. Another indication that will not escape the close observer and which the confessions especially reveal, is that of the boy lover off at a distance, "feasting his eyes" upon every movement of his "girl" who may know absolutely nothing about his devotion. He may be seen following her about the playground or along the street, always, however, at a safe distance. Although modesty shows itself as a characteristic trait of the girl even at this early age, she is on the whole more aggressive in these early love affairs than the boy and less guarded about revealing her secret. However, the impulse to conceal the emotion, —to inhibit its direct manifestations—is fundamental to this stage of the emotion's development in both sexes and is, as we shall see later, of the deepest significance.

As in every other field of investigation, so here, we find that not all of the facts conform to our classification. Thus occasionally couples between eight and twelve or fourteen years of age are found who enjoy each other's company and so pair off and freely express their feelings as they do in the previous stage and also in the one that follows. The boys of these couples are generally those of effeminate tendencies who have been accustomed to play with girls instead of with boys. They are never very highly respected by the other boys, and later, as adolescence, are tolerated by the girls rather than respected and sought by them. Again there are individuals who are very timid in their general disposition, and are consequently undemonstrative and inhibitive at all times.

We have emphasized the fact that children that have [illegible] ex- love in this second stage of its develo[illegible], as a rule, avoi[illegible] all direct expressions of their feelings ward, embarrassed, self-conscious presence. This is true when th personalities meet in mutual recognition without a third thing as a shield. They are not yet in that stage of development wherein they, themselves, become the chief objects of conversation and wherein endearments and compliments become the chief stock-in-trade. However, the emotion has its expression indirectly through games, plays and other incidents that can be used as masks. Instead of direct contact of personalities through the love confession as such, it is long-circuited through some conventionality. In this regard the games of children are used very effectively. The following games are the ones which I have personally seen used oftenest: Post-office, Clap-in-clap-out, Snap-and-catch-it, Skip-to-my-Lou, Way-down-in-the-Paw-Paw-Patch, King-William, London-Bridge, Thread-the-Needle, Picking Grapes, Digging-a-Well, Black-Man, Prison-Base, Tag, All-I-Want-is-a-Handsome-Man, Green Gravel, Down-in-the-Meadow, All-Around-this-Pretty-Little-Maid. These are merely the ones that have seemed favorites and by no means exhaust the list of love games that I have seen used. Out of eighty-three games of Washington (D. C.) children reported in the American Anthropologist, by W. H. Babcock,[1] as many as thirty are love games. In this, as in the previous stage, the embrace is the most important love expression and stimulus. But in this stage it takes on disguised forms or is excused by the ceremony of the games. Some are kissing games, *e. g.*, Post-Office, Paw-Paw-Patch, King William, Picking Grapes, Digging-a-Well, etc.; some are hugging games, *e. g.*, London Bridge, Thread-the-Needle, etc., and some involve both hugging and kissing, *e. g.*, Green Grows the Willow Tree. The kiss is not the frank love kiss given and received as such, but one called for by the rules of the game. This makes the kissing relatively impersonal and enables the young lovers thoroughly to enjoy the love communication without the awkward embarrassment that would come to them if the expression were not thus long-circuited through the game. The charm of the whole thing is in the fact that under the guise of a ceremony love has its way.

It will be helpful here to give a brief analysis of a few of the games as types. King William is a choosing and kissing game, involving among its details, the following lines:

> King William was King James's son,
> Upon a royal race he run;
> his breast he wore a star,
> to all a sign of war.
> the east, go look to the west
> the one that you love best,

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[1] , Vol. I, pp. 243-284. Also see Lippin-
eptember, 1886.

If she 's not there to take your part,
Choose the next one to your heart.
Down on this carpet you must kneel
As sure as the grass grows in the field.
Salute your bride and kiss her sweet,
Then rise again upon your feet.

The game is played by an equal number of couples and one odd boy who is King William. With hands joined, all forming a circle with King William in the center, the sentiment of the lines is acted out to music, thereby adding the charm of rhythmic dance which is so pleasurably intoxicating to the young and which has been taken advantage of by lovers during all ages. At the conclusion of the lines, King William joins the circle, leaving his bride to choose as the lines are sung again, and so on. Post-Office is another one of the most popular kissing games. It is an indoors game and requires two rooms, one to be used as the post-office, the other as an assembly room for the girls and boys. One of the number is chosen to be postmaster, and is stationed at the door of the post-office; another is elected to start the game by entering the post-office, closing the door and indicating to the postmaster the one for whom there are letters and the number of letters. This is then announced in the assembly room by the postmaster, and the girl (if it was a boy who started the game) is expected to respond by coming to the post-office and getting her mail, which means granting a kiss for each letter. She then remains in the post-office to indicate her choice to the postmaster, while the boy joins the others in the assembly room, and the game thus goes on indefinitely. The postmaster is usually granted, as his fee, the privilege of kissing each girl whose mail he announces. Picking Grapes is a game that calls for as many kisses as there are bunches to be picked. It further involves the holding of hands, and is not infrequently so arranged as to have the boy's arms about the girl's waist. Digging a Well is similar to Picking Grapes, and calls for as many kisses as there are feet in depth to be dug. In competition games where forfeits are sold there is no limit to the devices for indirect love expressions except the fertility and ingenuity in invention of the young people, and every one knows that in this particular regard their resources are well nigh inexhaustible. London Bridge is made use of to satisfy the hugging impulse. The game is played as follows. Two leaders agree upon two objects, for example, a horse-and-carriage and a piano,—as badges of their respective parties. Then they join hands and raise them to form an archway that represents London Bridge. The others in the game form a line and pass under this archway while all are singing:

You stole my watch and broke my chain,
  Broke my chain, broke my chain,

You stole my watch and broke my chain,
  So fare you well my lady love.

Off to prison you must go,
  You must go, you must go,
Off to prison you must go,
  So fare you well, my lady love.

he leaders may at any time let their hands drop down and h any one in the line that is passing through. The pro- ion then stops and the prisoner is asked in a whisper, hich would you rather have, a horse-and-carriage or a o ?'' According to the choice he or she passes around and s his hands about the leader's waist. The second one who es the same choice locks her hands about the first one's waist, so on till all have in turn been made captive and have ed one or the other side. The two lines, whose leaders still each other with hands joined, are now ready for the strug- that ends in the downfall of London Bridge. The following zas are sung, at the conclusion of which the pulling begins usually results in a general downfall and tumbling over another:

London Bridge is falling down,
  Falling down, falling down,
London Bridge is falling down,
  So fare you well, my lady love.

What will it take to build it up,
  Build it up, build it up?
What will it take to build it up?
  So fare you well, my lady love.

Lime and water will build it up,
  Build it up, build it up,
Lime and water will build it up,
  So fare you well, my lady love.

lackman is a catching and clutching game, and furnishes opportunity for hugging long enough for saying, "One, , three, pretty good blackman for me;'' and it often hap- that this is not said as rapidly as it could be,—especially be the favored one who is caught. Of course there is much niscuous catching, and the game is satisfying other in- cts than that of love, for instance the instinct of pursuing catching; but it is quite noticeable that the boys have their rite girls and catch them first, often showing jealousy if girls are caught by any one else. The girls are often ag- sive in selecting boys to catch in the event that they them- es are caught first. Prison-Base and Handkerchief are suing and touching games, and furnish opportunity for in- ct love confessions. Skip-to-My-Lou involves the choice of y Lou '' together with skipping with her, which is done while holding her hand or with arm about her waist as in round dancing. Green Grows the Willow Tree, involves holding hands, hugging and kissing. It is a ring game, with the one who does the choosing placed in the middle of the ring. The following is the song that furnishes the suggestions for the acting that accompanies it:

Green grows the willow tree,
  Green grows the willow tree.
Come my love where have you been?
Come and sit at the side of me.
  O, how she blushes so!
Kiss her sweet and let her go,
But don't you let her mother know.

Tag and I Spy are other games that furnish opportunities for love to discriminate in favor of its chosen ones. In fact there is scarcely a social game indulged in by both sexes wherein the incidents are not turned to the emotion's account by the young lovers. It must not be understood that all of the children who take part in these games are to be considered as lovers. As was suggested above the games may appeal to many other instincts and be indulged in on that account rather than on account of the love sentiment that characterizes them. On the other hand many of the games whose content does not suggest love may be turned into a love opportunity and expression.

The routine of the school furnishes other opportunities that are taken advantage of. Lovers will manage some way to sit or stand together, and are thrilled by touching. One boy who sat behind his sweetheart would place his arm along the back of the desk where she would come in contact with it. Others carry on their courtship by touching their feet under the desks, etc. It is common to see favoritism in recitations wherein pupils make the corrections; the lover seldom corrects the sweetheart, and *vice versa*. In contests such as spelling, words are purposely misspelled in order to favor the sweetheart or to keep from "turning her down." The eye glance is another means as efficacious with children as with adults. One pair of young lovers, whose unsympathetic teacher forbade their looking at each other, brought hand mirrors by means of which they continued to exchange their "love messages."

Few teachers complain of the love affairs of children in these first two periods as interfering with school work,—except when one of the lovers is absent. A score or more of the observers assert that during the absence of one of the lovers, the other does not do as good work and often becomes moody and irritable. On the other hand it very materially quickens the efforts of many who want to appear well before their lovers.

One boy, nine years old, who had been quite lazy and was looked upon as being rather dull, braced up and for two years led his class, in order, as he said, "to win his Ottilia." During the adolescent stage that follows this the emotion becomes so intense and all absorbing as to interfere very much with school work, or with anything else that requires application.

Akin to the disturbance caused by the absence of the lover from school is the grief that comes from being more or less permanently separated, as by moving away or by the death of one. In some instances the grief is very intense and protracted. Four cases of attempts at suicide are reported: one boy eight years old; another nine; a girl nine and another eleven. Six cases of nervous illness are reported as due, either to separation or jilting. Ordinarily, however, weaning is comparatively an easy matter.

Teasing breaks up many of these love affairs, and not infrequently causes the lovers to hate each other; in which case they childishly look upon each other as the cause instead of the occasion of the torment. Also under the spur of the taunts of mates the lovers are stimulated to say things to or about each other that lead to estrangement. In some instances, however, the persecution is taken as a sort of martyrdom and is enjoyed. Jealousy is another potent factor in separating these young lovers. Teasing is not the primary cause of the tendency to conceal the emotion.

The season of the year seems to have its effect upon the intensity of the emotion of sex-love among children. One teacher from Texas, who furnished me with seventy-six cases, said that he had noticed that the matter of love among children seemed "fairly to break out in the spring-time." Many of the others who reported, incidentally mentioned the love affairs as beginning in the spring. This also agrees with my own observations. It may partly be accounted for by the fact that during the winter months the children have much less freedom in playing together, and hence fewer opportunities for forming and showing preferences. On the other hand the suggestion inevitably occurs that there is some connection between this and the pairing season among animals and the sexual periodicity among primitive peoples.

"Showing-off" as a method of courtship is not only as old as the human race, but is perhaps the most common one used by animals. While the complete discussion of this topic is reserved for the chapter upon courtship, the picture of love as it is experienced by the young people in this second stage would not be complete without at least a passing reference to it. It constitutes one of the chief numbers in the boy's repertory of love charms, and is not totally absent from the girl's. It is a most common sight to see the boys taxing their resources in devising means of exposing their own excellences, and often doing the most ridiculous and extravagant things. Running, jumping, dancing, prancing, sparring, wrestling, turning handsprings, somersaults,—backward, forward, double,—climbing, walking fences, singing, giving yodels and yells, whistling, imitating the movements of animals, "taking people off," courting danger, affecting courage, are some of its common forms. I saw a boy upon one such occasion stand on the railroad track until by the barest margin he escaped death by a passenger engine. One writer gives an account of a boy who sat on the end of a cross-tie and was killed by a passing train. This tendency to show off for love's sake, together with the inability to make any direct declaration, is well illustrated in the love affair of Piggy Pennington, King of Boyville.[1] "Time and time again had Piggy tried to make some sign to let his feelings be known, but every time he had failed. Lying in wait for her at corners, and suddenly breaking upon her with a glory of backward and forward somersaults did not convey the state of his heart. Hanging by his heels from an apple tree limb over the sidewalk in front of her, unexpectedly, did not tell the tender tale for which his lips could find no words. And the nearest that he could come to an expression of the longing in his breast was to cut her initials in the ice beside his own when she came weaving and wobbling past on some other boy's arm. But she would not look at the initials, and the chirography of his skates was so indistinct that it required a key; and, everything put together, poor Piggy was no nearer a declaration at the end of the winter than he had been at the beginning of autumn. So only one heart beat with but a single thought, and the other took motto candy and valentines and red apples and picture cards and other tokens of esteem from other boys, and beat on with any number of thoughts, entirely immaterial to the uses of this narrative." This "showing-off" in the boy lover is the forerunner of the skillful, purposive and elaborate means of self-exhibition in the adult male and the charming coquetry in the adult female, in their love relations.

Another kind of indirection that is very interesting is that of a boy who ostensibly is talking to one, but everything which he is saying is intended for another. This is sometimes extended into a sort of pleasant teasing and scuffling in which the very one whom he wants to touch is very carefully avoided. A further phase of the same thing is shown by the embrace or caress that is given to one while the emotional discharge goes out to some one else; as for example, a boy under the influence of a meeting with the girl whom he had begun to love but to whom he had made no confession, went home and walked up to his sister, put his arms about her neck and kissed her. The action was so unusual as both to surprise the sister and to arouse her intelligent suspicions. Goethe makes much use of this type of emotional discharge in his "Elective Affinities," and Tennyson alludes to it in the lines,

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[1] McClure's Magazine, February, 1897, p. 322.

> Dear as remembered kisses after death,
> And sweet as those by hopeless fancy feigned
> On lips that are for others.

Such manifestations are not far removed from those that are shown to pet animals and to persons of the same sex, reference to which has previously been made.

Previous to the age of about nine the girl is more aggressive than the boy in love affairs. At this age her modesty, coyness and native love for being wooed, come to the surface and thereafter characterize her attitude toward the opposite sex.

TYPICAL CASES.

Case 1. A boy of eight confessed through a girl's friends his love for the girl. Then on the playground he did little favors for her as though they were matters of course. If attention was in any way called to his acts of kindness he would lightly dismiss the affair with "Oh, that 's nothin'," always showing embarrassment at the fact that his favoritism had been observed. In writing about it the girl says: "I liked him very much and enjoyed being near him on the playground, but was very much embarrassed when he spoke to me; so about all the pleasure that I got out of this little romance was in watching him as he would try to gain my attention and good-will while we were all at play."

Case 2. In a case that continued from seven to thirteen the writer says: "I wanted to stand by him in the game, but would never make the effort to get the situation—although it always came about. He sent me very pretty valentines, but was very careful that I should not find out who sent them. When we met on the street we would both blush, and a strange feeling would possess me that I did not have on any other occasion. My bliss was complete when I was walking down the street and he overtook me—although we could say nothing to each other."

Case 3. B. 9, g. 11. Boy very much annoyed by the fact that the girl was two years older. He thought that the husband ought always to be older, and "looked forward to the time when I should make her my wife. It was in secret, however, and I was always fearful lest some one should find it out. The girl probably never bestowed a thought upon me. I was very shy in her presence, and if she spoke to me or addressed me in any manner my tongue clove to the roof of my mouth, making it almost impossible for me to answer. I dreamed about her night after night, and upon hearing her name mentioned I would become confused and nervous." This continued from nine to fifteen, and developed into a genuine case of adolescent love.

Case 4. B. 11, g. 9. Boy would come to take the girl to their little parties—but would never walk on the same side of the street with her. The girl writes: "We were very much afraid of each other, and yet we were n't. When we were together we never would speak to each other if we could help it, but when we were apart we wrote notes constantly."

Case 5. "I was very much in love with a boy when I was between seven and nine years of age. I always felt hurt if he chose any one else in the games. I was very much embarrassed if this boy's name was mentioned in the presence of my mother or brothers. I did n't mind their teasing me about any other boy. I felt none of this embarrassment in the presence of my sympathetic playmates."

Case 6. An eight-year-old boy contemplated suicide because his sweetheart moved into another neighborhood. He would not tell her that he loved her. Wanted to give her a present, but feared she would divine the truth.

Case 7. From a woman's confessions, referring to her love at nine years of age: We never used the word *love*, it was always *like*. I think we felt afraid of *love*. I think we had no definite idea of marriage, we lived completely in the present. However, I felt in a dim way that we were always to be together.

Case 8. From a man's confessions: "I never told any one that I loved the girl, and did not even want the girl to know it. I was satisfied to be in sight of the girl. I was nine and she was ten."

Case 9. B. 9, g. 8. A blue-eyed girl and a handsome dark-eyed boy. One day he told Bessie he had something to tell her, but that she must tell no one. He said that he had wanted to tell her before but could not; now he would tell her if he choked to death in the effort. Braving all difficulties, he led Bessie to an oak tree and while pretending to be gathering acorns, told her of his love. She forgot that she should "tell no one," and at the first opportunity told me the whole story, and how she had loved him, but had never imagined he cared anything for her. I had understood Bessie's feelings before she told me this, and now rejoiced with her. She wanted to be with him almost constantly, but he was shy and always wished to conceal his affection from every one except from Bessie. She thought the mutual love something to be very proud of, and could not understand why he could not tell every one unblushingly as she did. She talked of a far-away sometime when she should be his wife; he, terribly embarrassed, acknowledged the fact when she mentioned it in his presence. This condition of affairs continued about three months, when she gradually came to the conclusion that he did not love her and she would give him up for one she knew loved her. This was a young man of seventeen or eighteen who delighted in holding her on his knee, playing with her curls and caressing her in different ways. He cared for her as boys of that age usually care for little girls. Milton, filled with jealous anger, remained at a distance for awhile, and then spoke of the unusual proceedings to Bessie. She told him in child language that "When one is truly in love one not only says it but shows it," and having fallen desperately in love with the more fortunate young man
to understand that he need hope no more. The new
ut a short time, and after bestowing a beautiful doll
he went away. She cried, was sorry that she had mis-
n, but was too proud to call him back, and contented
oll, declaring she did not like boys, and would never,
again. Milton with his parents soon moved away,
him again.

. 16. A boy of ten very much in love with a girl of
te letters which they exchanged in some secret way.
ome of the letters which the boy had received from
she was profuse in her expressions of love. The girl

did not seem to care if her love for the boy was known, but the boy was shy. This continued for some time, in fact, until the young lady was engaged to be married to a young man, and within a week of her marriage she told her grandmother that if H. were but a little older her eyes would be turned in a different direction.

Case 11. The two children I refer to were about nine years old. They seemed to think a very great deal of each other, but were very shy in the presence of others. He often sent the little girl presents of flowers and candy on the sly. They continued to love each other for three or four years, until they finally became estranged through jealousy.

Case 12. When I was nine years old I fell in love with a girl about my own age who was also in love with me. I was jealous when I saw her playing with any other boy. I never told any one that I loved the girl, and did n't even want her to know it. As I grew older it gradually disappeared without anything to break it up.

Case 13. From the age of seven to ten I loved a boy of my own age. It happened occasionally that the class would stand up to spell, and when it did we frequently stood side-by-side. When the teacher allowed the school to spell in the old-fashioned way of "turning down" we were averse either to go above the other when we were entitled to do so. Our childish happiness lasted but one school term. His family moved away. We both felt the separation very keenly, and were sure that we never would have such friends again. At ten I thought more of another boy who had recently moved to our town. Our love began by our playing together in games with others. Our attachment grew to be very warm. He would send me valentines, and I would usually answer them. We were together in our study and in our games and sports. He would choose me and I would choose him,—except occasionally to tease him I would choose his nephew who was a little older than he. At times he did not appear to care, but at others he became angry. This love continued for four years with occasional interruptions in its placidity.

Cases of early love continuing throughout life. Case 6, page 335, and case 11, page 336, also belong to this group.

Case 1. My father and mother fell in love with each other when they were five years old, and were lovers till they died, both at the age of sixty-seven. When they were children they lived in the country some miles apart. Their parents attended the same church, and on Sundays in the summer-time the children were allowed to play outside while the church services were going on. It was in this way that they met, and for some time they saw each other only on Sundays. When seven years old they started to the same school, and from that time on they were very devoted lovers. They were married at twenty-two, and lived happily together during forty-five years. They raised a large family, all of the members of which are now grown.

Case 2. I know of a couple who have been married ten years who have been lovers since childhood. The husband is four years older than his wife, with whom he fell in love when he was seven years old. They lived in the same town, and their parents were the best of friends. The children had many opportunities for being together, and always seemed very happy in each other's company. They were always acknowledged to be lover and sweetheart by their playmates, and it seemed very natural that they should marry, which they did when she was seventeen.

Case 3. I have a friend who is about five years older than I. We have been very intimate, and she has told me everything about her life. She and her husband have been lovers since they were five years old. She says that there has never been a time in her life since that time when she did n't love him. They were neighbors when they were small children, but moved apart and did not see each other for years. She went with friends to Europe and had many interesting experiences with other suitors, but her love for that boy never changed except to grow stronger. They have been married several years.

Case 4. During the time that I was teaching I boarded for several terms in a family, the husband and wife of which told me that they had been lovers since the first year that they attended school, and that neither had ever had any other lover.

Case 5. Two young people that I know have been lovers since they were babes. During their early school years the little boy would call for his little sweetheart every morning and take her to school. He was always at her side during the play periods, and would walk home with her after school was out in the afternoon. When either was sick the other called regularly and brought little favors. They have been very jealous of one another during all of their life. They are now twenty and soon will be married.

Case 6. I know a couple who were married at the age of nineteen whose love began when they were children. Their parents were neighbors, and the children grew up together. During their childhood their love was not interfered with by the parents, but when they arrived at adolescence and began to go to parties together the parents of both objected. The most severe measures of the parents of both failed to prevent their marriage.

Cases with disparity in the ages of the lovers.

Case 1. A little boy of four began to show the most devoted love for a young lady. Even when she was absent the mention of her name would cause an expression of almost worship to pass over his little face. She gave him her picture, and every night he said his prayers to it and kissed it good-night. There was no cloud in his sky until one day he heard two members of the family discussing the arrival of a young man who was interested in the young lady. No notice was taken of the little one, and when dinner time came he was missing. He was found in the carriage-house—a little bundle of indignation—getting ready to drive down town. In the carriage he had put his father's shot-gun, and he vowed vengeance on the young man who was "stealing away" his "darling," as he called her. It took some time to pacify him, and he was only satisfied when the young lady herself appeared on the scene and promised him she would not marry the young man. That was nearly three years ago, and he is still as devoted a little lover as he was then.

Case 2. A little girl of five showed great affection for a boy of twenty-one. She used to climb upon his lap and caress him, and he never forgot to have some little delicacy for her in his pockets. This little girl had a pet kitten which her parents did not wish her to play with, and so her brothers coaxed the young man to kill it, thinking that she would think anything which he did all right. But the child's conduct towards him changed, and she did n't care for him as before. She is now nineteen years old, but whenever she sees him she thinks:—"He killed my pet."

Case 3. I knew of a little girl not more than four years of age who became warmly attached to a young gentleman. He laughingly said to the child "I will wait for you." She did not forget the remark, but looked upon him as her ideal. Every act of friendship between him and other lady friends was noticed with a jealous eye by the child. The young man travelled through the West, and while there met a lady who later became his wife. When the child learned this she was very angry and hated the lady. She did not feel differently about it until she was grown.

Case 4. A girl ten years old became very fond of a young man of nineteen while they both were attending school. She would wait for him to walk home with her from school. She took great pride in her personal appearance, and would always wonder if it would please him. This affection lasted through one winter and the next summer. After that the girl seemed to care for the boys of her own age.

Case 5. The last year I taught there were two little boys, Lambert, aged seven, and Frank, aged six, who fell in love with me. Lambert was very demonstrative when alone with me or when only grown folks were around, but did nothing in the presence of his schoolmates. He would put his arms around me, kiss me, and was very happy when he could sit on my lap. He gave me very few presents, but dearly loved to be with me, and often asked me to wait until he grew up so that he could marry me. He very frequently told me how much he loved me, and would ask me if I loved him, and if so whether I loved him more than I did others. Frank was very bashful, and though he would stay near me, would never come very close. He would watch my actions very closely, and tried to please me in every particular. Nearly every day in spring he would bring me a bouquet either of wild or tame flowers. Quite frequently he brought me fruit. If he had only one apple or banana he was never satisfied until I had taken a bite.

Case 6. A boy about ten years old loved a young lady of twenty during two years. Jealousy conspicuous. Expressions of love in the giving of small gifts, such as fruit, flowers, etc. Actions of the boy quite free and gallant in the presence of others. No tendency to withhold demonstrations and be satisfied with love at a distance. On the contrary, he seemed to seize every opportunity to show the lady attention. At about twelve years of age the boy began to hate her as extremely as he had formerly loved her.

Case 7. A little girl three years of age claimed me as her lover. Whenever I called on her parents she rushed to me and wanted me to hug and kiss her, and was never backward in doing her part. If at any time I did not notice her solicitations she would turn away from me and, going to some remote corner of the room, would cry as if her little heart would break. Jealousy was very prominent in her.

Case 8. A little girl three years old and a young man between twenty-five and thirty. It has continued now for about six or eight months and is mutual. The little girl says she is going to marry Mr. ——, and he says he wishes he could find a big girl that he thought as much of or that she was a young lady. She is very careful to always be nice in his presence. Will sit on his lap and love him, and seems happier than with any one else. She will ask her mamma "When will Mr. —— come to see me?" One day I met him and he told me to tell her that he would be in that afternoon. I did so, and she was very much delighted—ran and told the other members of the household. She seated herself in the parlor and would look at her clothes and brush them and sit in as prim a position as possible. She seemed to want to look her best. Her kindergarten teacher tried to coax her to go to her room; she said, "Oh no, Mr. —— is coming to see me," and would ask impatiently when I thought he would come. She acted the same when alone or with others. She was very jealous, and never wanted any other lady to sit nearer him than she was. She would often say "He is mine." She did not object to gentlemen sitting by him. No gifts on either side.

Case 9. Last October a boy of four met for the first time a young lady of eighteen. He at once became strongly attached to her, and during the week they spent visiting the same family he was almost constantly at her side. He would sit on her lap with his arms around her neck, and sometimes shyly kiss her. He would leave his mother and go with the young lady in preference. He wanted to be doing everything that she did. The older boys teased him, but he did not care. Said she was his girl, and always would be. He cried for her to go with him when he went home. He has not seen her since that time, but they have her picture, and he takes it and kisses it and calls her his sweetheart.

Case 10. A little cousin named Blanche when about two years of age became greatly attached to a man who worked for her father and lived with the family. He was probably thirty years her senior. The feeling continued growing stronger for about four years, when it was broken off by her finding out that he "had another girl." She told me once that she loved him more than she did her papa or mamma, and that when she grew up would go and live with him. When she got presents for any of her friends he was always remembered. She was very demonstrative, sitting on his lap and in many other ways showing her feeling for him.

Case 11. A young lady of twenty years and a boy of six. We all boarded in the same house. He was so attached to her that he would never go to sleep without kissing her good-night. The very coldest day in winter if his mamma did n't have his coat and mittens on him when the bell rang for twelve o'clock or for six o'clock he would go without them to meet her, for he knew that she came at that time. He was always asking if she loved him, and if she would wait until he was a man and marry him. This continued for nearly three years when, one day, a lady whose hair was gray called on his mamma. He did n't like her, and after she left said to the young lady "I won't marry you when I am a man for your hair will be gray." After that he never cared particularly for her.

Case 12. I know of one case where a little boy about six years old fell in love with a lady about twenty years old, and always used to call her his girl. He used to go and put his arms around her and kiss her at any time; it did not embarrass him if some one was looking at him. He is about eighteen now, and seems to think a great deal of her yet.

Cases showing the continuity of the emotion through the first three stages of its development.

W., 18. I cannot remember a time before I was fourteen years old when there was not some little boy whom I loved. The first case that I can recall occurred when I was five years old. I know that I was five for I have heard my parents say how old I was when they moved away from that place. After we moved away I never saw him any more. We came to another town and I started to school. I was rather afraid of all the little boys, but some of them I liked very much. I can remember one big boy whom I did n't like. He was always trying to play with me, but I thought that I just hated him. One day he caught me and kissed me. It did n't frighten me, it simply made me very angry. I was so provoked that I cried and slapped him in the face as hard as I could. The little boy that I did like at that time was a red cheeked boy with dark hair and blue eyes. I do not remember any particular incident, but I know that we played together all of the time and thought a great deal of each other. I was then about seven years old. By the next year of school this boy had moved away, but another little boy came to school whom I liked better. His name was Ray. I can remember him better than I can the others. For a long time I thought that he did n't care for me, and while I thought that I was afraid of him;—that is, when I met him I was so bashful and trembled so, because I was afraid that he would find out how I loved him and would make fun of me. Our teacher believed in having little boys and girls sit together in school so that they would not be bashful. I had always sat alone, but now for some reason or another she put Ray in the seat with me. I could not study or do anything with Ray so close to me. I was almost afraid to look up till one day he told me that he loved me. Then I found out that he had been afraid all of the time that I did n't like him. I was over most of my shyness then. I suppose that my teacher concluded that she had cured me of my bashfulness. I wore short dresses then that just came to my knees. I was good at wearing out my stockings at the knees, but my mother was such an excellent darner that it took the closest scrutiny to find the darned places. One day Ray noticed this darning and asked me if my grandmother did it. I told him that my mamma did it. "I wish that I had some one to darn for me like that," he said. I told him that mamma was teaching me to darn that way. "Well," he said, "when we are married you will know how and can darn mine that nice." That was the first that I had thought of our getting married, and I can remember how proud I was to think that he cared so much for me. He was always very good to me, and we never quarrelled. Our love continued about two years. He moved to the city when I was ten years old. He was about a year and a half older. I have seen him only twice since then. The summer that I was eleven years old I met a little boy who was visiting his aunt, our neighbor. He was a year older than I. I cannot remember his name, but can remember how he looked. I loved him the same as I did Ray, except at the time I thought I loved him much better. I did n't know whether he loved me or not, but I thought that he did, because I noticed that he was just as nervous when we were together as I was, and turned his eyes away when I looked at him just as I could n't help doing when he looked at me. One day I told Grace, his cousin, that I liked him better than I did any one else I knew. I said that I believed that I liked him better than I did my mamma. He had been at his aunt's two months, and I told Grace this just the day before he was going away. On the next day he came over in the forenoon and found me standing alone by the rain-barrel, thinking about him and almost crying because he was going away so soon. We stood and talked awhile, and then he said "Say, did you really mean what you said to Grace yesterday?" I can remember just how he looked at me when he said it. I wanted to tell him that I did. Then I thought that I would tease him. So I pretended that I did not know what he meant and tried to get him to tell me what it was. He kept telling me that I knew what it was and to please answer him. But I kept pretending that I did not know. I remember that I thought that I had better not say that I did because he had n't yet said that he loved me. At last he said, "Please do tell me, I would be *so* happy if I knew that you meant it." I was just going to tell him that I did mean it when mamma called me to come in and help her, so I had to go without telling him. He went away that afternoon, and I have never heard of him since. I cried that night because I had not told him what he wanted me to instead of teasing him. The last boy that I fell in love with had twinkling blue eyes, dark hair and dozens and dozens of freckles. He was what the people call a "holy terror," but every one liked him because he was so free-hearted and ready to help everybody. I do not know how I happened to fall in love with him nor when, but I did, anyway. He was a favorite with the girls, and that is what spoiled him. He got into the company of bad girls and boys, and before he was fifteen years old he was the worst boy in town. He is now about twenty-one or twenty-two, and no respectable girl will have anything to do with him. I prayed and prayed that he might be changed, but it seemed that it was not to be. I was only a child then, but I loved as earnestly as any woman ever did. After a while my feelings changed. For a time I hated and loved him by turns. Then I began to feel sorry that he could not be good, and so finally I only felt pity for him.

M., 34. I remember that when I was three years old I was very much in love with a young lady of eighteen, the grocer's daughter, who was one of our neighbors. She was especially fond of me, and came for me nearly every day to spend a part and sometimes the whole of the day with her. My sister was married in the month before I was three, and I remember many of the incidents of the wedding. That event marked the first that I can remember about my love for Miss Carter. This love lasted during three years,—until I started to school. Then I soon fell in love with another young lady,—a very beautiful and popular French girl of eighteen. I asked my teacher if I might sit by her. He told me that I might if she were willing. I at once asked her, and she made me very happy by giving her consent. I was her seatmate during all of the remainder of that school year. I was very jealous about the attentions which she received from her many admirers, and was thoroughly miserable during the days that she was absent from school. There was another young lady in the same school whom I loved at the same time, but not with the intensity of my love for my seatmate. In my seventh year I fell in love with a little girl about my own age. I loved her very much, and she loved me in return. We were free and natural in our demonstrations of kissing, embracing and exchanging gifts and attentions. In the case of the two young ladies who were free and even excessive in fondling me, I was relatively passive, but enjoyed all their expressions of love very much. During the years from eight to twelve I was very desperately in love with a girl three years older than I, but about the same size. She was a very beautiful girl with expressive brown eyes and dark but clear complexion. She liked me very much, and it was understood among our playmates that we were lovers, although we were more reserved toward each other than we were toward any of the other school children. I do not know how my secret was discovered, because I had not told any one. I wouldn't have told her for anything. I couldn't have. It was very embarrassing for me to speak to her, although in Blackman I always tried to catch her, and usually succeeded for she didn't try very hard to get away. In playing "I Spy," if I was "it," I always allowed her to get to the home goal without spying her. In other games, such as "Dropping the Hand-
" or choosing games she was the one whom I favored. Any lit-
sy that I could show her filled me with keen delight, although
nted her to take any notice of it. I wanted her to under-
not to mention it. The secret understanding between us
embarrassing thing,—it was any expression of our love
other that we could not stand; any reference to it by
so very embarrassing. I do not think either of us was
I could not easily keep my eyes off of her during school
in the recitations, if I chanced to sit or stand by her, I
vous and could feel my heart beating with great violence.
cted her in class, and have purposely missed many a
ng to keep from turning her down. I never wrote her
ny way confessed my love for her except in such acts as

those which I have enumerated. She moved away from our town when I was twelve. I grieved over it for a year or more,—until I fell in love with another girl. This was my first adolescent love, and came over me with great power. The girl was about my own age and loved me as much as I did her. During the first year of this love we were both somewhat shy. We wrote notes and made the most extravagant confessions on paper, but would carefully avoid such in our conversations. In the choosing games we nearly always chose each other. In the kissing games I was the only boy whom she would kiss. There was one other boy whom she would allow to kiss her. I was very jealous of him although he was my chum. At fourteen we had passed our shy stage, and then became very demonstrative and sought each other's company outside of school. We exchanged love-letters very frequently. Some of these were twenty to thirty pages long, and were more poetic and beautiful than anything that I have been able to write since. I have some of them yet, and read them with much pleasure. My love for this girl lasted through more than three years, during which I was never absent from her home on Sunday. Our relations were encouraged by her parents. We had the usual love quarrels and temporary estrangements on account of jealousy, but they were soon over. At seventeen I left that town to teach school in another town fifteen miles away. She was attending school in the academy. While I was away two of my rivals perfected a plot that effected our estrangement. For a year we did not speak to each other. Then there was a sort of reconciliation, but nothing could undo the harm that had been done. I have not seen her for thirteen years, but I still think of her very kindly and recall our youthful romance as a pleasant and sacred memory.

W., 31. When I was about three years old a little boy of two lived near us. Our parents were warm friends and encouraged the love affair that soon sprang up between us. Our love was open and quite as a matter of course, we were very demonstrative and not in the least embarrassed by observers until I was about six, when we became more shy. We played house, and were always man and wife. Scarcely a day passed which we did not spend playing together from morning until night. Neither of us cared anything about playing with others. Once I remember as I was going home from the store carrying a little basket, Walter's cousin, a boy of about the same age, offered to carry it for me. He had no sooner taken it than Walter overtook us and commanded him to give him the basket saying that he *always* took care of me. When the young gallant refused to give up the basket Walter took it from him and, putting it at a safe distance, proceeded to give him a pounding. Then he took up the basket and walked home with me. I remember that I enjoyed this scene very thoroughly. We were almost inseparable for five years, when my family moved out West. We exchanged gifts and promises of eternal love, but the parting was very sad. We promised to wait for each other and marry some day. Within the next two years he sent me gifts and I sent him gifts and letters. His mother said he enjoyed getting the letters but was too shy to answer them, and was very easily teased about me. I was very proud of my lover, and told my new little friends about him. I was very happy when he sent me a photograph of himself neatly framed when he was about nine years old. Although we still considered ourselves sweethearts we were each enjoying love affairs at home. During my ninth year I had a lover about my own age. He was very popular among all the girls because of the gifts he distributed liberally. I was decidedly his favorite, and was proud of the distinction. We were shy before grown people, but at school were acknowledged lovers. While not openly demonstrative, we took advantage of our games to show our love by choosing each other and giving the kiss or other mark of affection required by the game. We especially enjoyed walking home from school together or playing together when no one else was by. My heart was almost broken when it was discovered that he had been stealing small sums of money for some time in order to give me the gifts which had made me so happy. I was not allowed to have anything more to do with him, and he soon moved away. About this time I fell in love with a young man twice as old as I. He worked in my father's office and boarded with us. I loved to be with him, and was especially happy when he took me with him to church or some entertainment. When he would take me by the arm and help me through the deep snow I felt very grown up and proud of his attention. He cared for me as a little girl and I worshipped him as my knight. I was very jealous when he showed any young lady attention. Soon after this my father died and we moved to a lonely station on the prairie. Again I fell in love with a man more than twice my age whom I saw very seldom. I was very happy when he took me on his lap or caressed me. I was very shy both with him and about him, but magnified every look and word and act until I convinced myself that he loved me as much as I did him. I was intensely jealous, and when I did waken to the fact that he loved a young lady I was nearly heart broken. No one dreamed of this except a girl confidant. His marriage several years after hurt me. I think he never suspected my feelings. When about thirteen a boy a little older than I moved into our town from the East, and we proceeded to fall in love with each other at once. We wrote long letters to each other daily,—although we sat across the aisle from each other—and handed them to each other slyly when we thought no one was looking. When I was obliged to remain at home one week he brought me a long letter each evening after school. These letters were full of love and jealousy, and were read over and over, and were often carried next the heart. We took long walks and rides together, but I cannot recall a single caress given or received during the two years we were acknowledged lovers. I had received very strict teaching in regard to such things. Both of us were easily teased and very bashful when observed by others. When he was sent to a town fifteen miles away he felt sure I would forget him and that this meant the end of our beautiful love. I grieved over his leaving and because we were not allowed to correspond, but was really beginning to love a young man somewhat older so much that I was not inconsolable. We were very jealous of each other, and the news which came to each did not contribute to our peace of mind until we gradually grew apart. This affair was renewed later, and was of quite a different character.

FIXED VISUALIZATION: THREE NEW FORMS.

By Dr. Edward Franklin Buchner, Docent in Philosophy, Clark University.

In making a record of the following case, which was first reported at the New Haven meeting of the American Psychological Association, the language used by the subject in verbal description is selected from the stenographic records. The language aids the reader to appreciate the manner in which the forms are experienced and apperceived by the subject. The case is of interest on account of the variety of forms, their permanency and certain uniformities characterizing them.[1] The diagrams, I to VI, in the chart on page 356, representing selected features of the forms for numbers, days, and months, will give fixity to the descriptions. The diagrams are reproductions of the "geography" of the various units in each form as they were located on a large scale by the subject. Diagram I shows the number form, diagram II, the month form, and diagram III, the day form in the horizontal plane. All the numbers from one to one hundred appear in their serial places, as indicated in I. The relative locations of the three forms, as experienced by the subject, can be ascertained by mentally superimposing the point of regard in II-III upon the point of regard in I. Although the day and month forms are never visualized simultaneously, diagrams II and III have been sketched with the same point of regard, so as readily to indicate their points of contrast and agreement.

Selected details of the number form are sketched in diagrams IV-VI. IV is a vertical section, showing the elevation of the respective numbers indicated, AB being the horizontal plane of vision. V is designed to represent the elevation in the series from one to twenty-nine. The remaining groups of tens repeat the variations in elevation thrice indicated in V, but at a greater inclination, are represented in VI. I may add that the original sketches were repeatedly verified by the subject. (In VI, the inclines of all groups from thirty to ninety should be parallel. It has been impossible to secure the geometrical accuracy in the case of seventy, eighty, and ninety in VI and IV, which tends to be a feature in the other localizations.)

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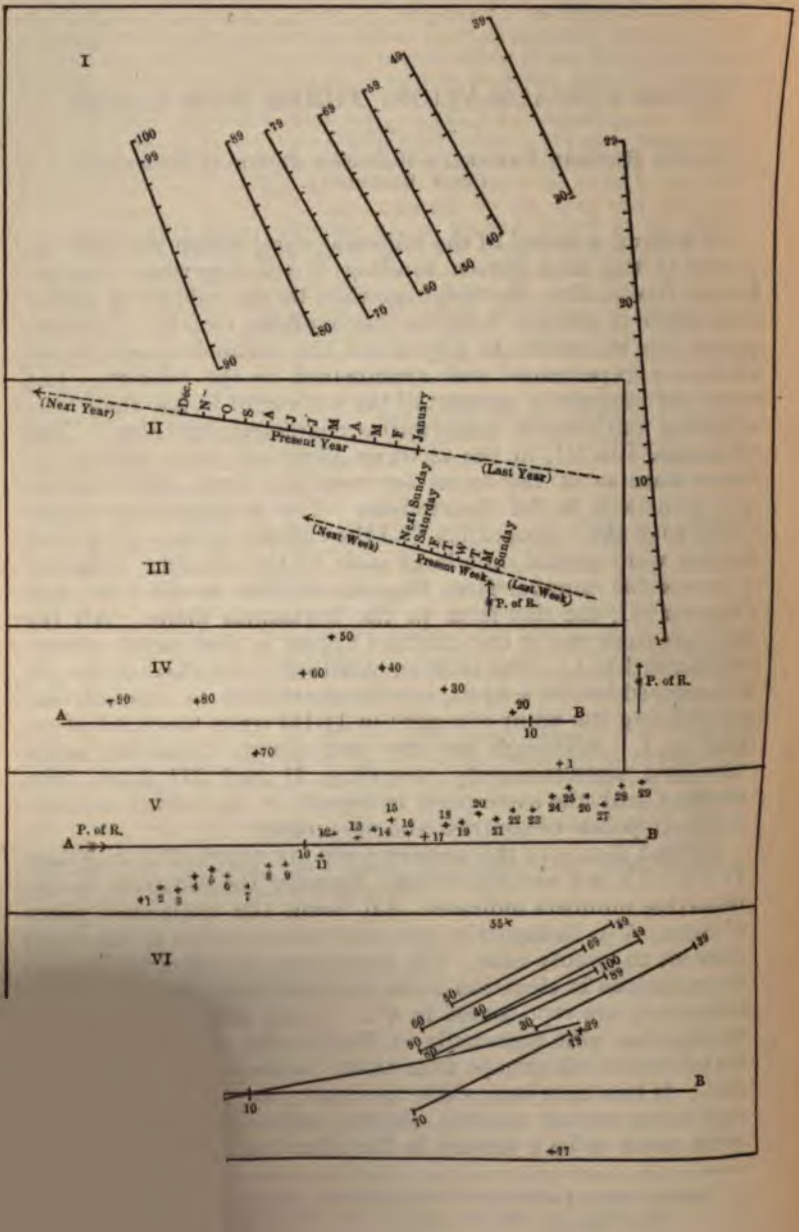
[1] Descriptions of additional forms are to be found in this *Journal*, Vol. V, 1892-1893, pp. 265 ff., 439 ff.; Vol. VIII, 1896-1897, pp. 506 ff.


I
II
(Next Year)
Dec.
N
O
S
A
J
J
M
A
M
F
January
Present Year
(Last Year)
III
Next Sunday
Saturday
F
T
W
T
M
Sunday
(Next Week)
Present Week
(Last Week)
P. of R.
IV
A
B
P. of R.
V
P. of R.
A
B
VI
B

I. The Number Form.

The number-form appears to the subject in a half fan-like radiation, extending forward and to the left of the mental point of regard. This composite feature appeared gradually from the following description: "I look down to one, which is very near me and slightly to the right. Two is farther away and above one. Three is lower than two, but not so low as one. Four is sharply above three. Five is higher than four, and beyond four. Six goes down below five. Seven is more below six than six is below five; in fact, seven seems lower than one though it is beyond one. Eight rises sharply from seven, more sharply than four is from three. In regard to nine, it is difficult to tell whether it is above or below eight. I think it is very slightly below eight, being on the incline. Ten is above nine, and is directly opposite the mental point of regard, in the horizontal plane. Eleven is a little below ten. Twelve is above eleven. Thirteen is a little below twelve. Fourteen is above thirteen. Fifteen is above fourteen, being quite high, so that I have to look up to it. Sixteen is below fourteen. I never think of sixteen being on a level with thirteen, but think of a number only in relation to the one preceding and the one following it. Seventeen is below sixteen. Seven is the lowest number in the first series of ten. This is true of all the tens. The series of seventy is the lowest in the whole series, seventy-seven being the lowest of all the numbers. Eighteen rises sharply above seventeen. Nineteen is to eighteen as nine is to eight, but beyond it. I think of it as lower, but know it is higher on account of the incline. Twenty rises above nineteen. Twenty-one is a little lower. The varying positions of the numbers from twenty-one to twenty-nine repeat the variations in the series from one to ten."

"The numbers fall into groups as follows. One to twenty-nine are in a continuous direction. Twenty-nine seems about twelve feet distant from me. The next group includes thirty to thirty-nine, and lies to the left of the twenties. Thirty is about as near me as twenty-seven. The numbers in this group seem to bank themselves together in an incline that is steeper than the incline occupied by one to twenty-nine. The next group includes forty to forty-nine, and lies to the left of the thirties. These numbers are arranged in a manner similar to those in the thirty group. The remaining groups include the fifties, the sixties, the seventies, the eighties, and the nineties, one hundred being beyond ninety-nine, each group being arranged similar to the thirties."

"The numbers in the twenty series stand out as distinctly as the first few numbers. I do not think of their size, but only of their locations. I see these numbers as we ordinarily write them, that is, the numbers up to twenty. Though I can put it in a figure, I usually think of the word 'seven.' The word 'one' is very short in comparison with the word 'sixteen.' From twenty to twenty-nine the numbers seem to appear; in the thirty group the words."

"The series one to twenty-nine seems darker than the surrounding space. The words are not illuminated. The word itself is darker. The space around it seems gray. There is no difference in the shading from one to one hundred. There is no illumination; all seems dark. In the side series I see nothing at all; that region does not appear except when I try to picture it." (Later analytical experience with the form revealed that the whole form could be made to stand out at once.)

"I never find, for example, a number from one to twenty-nine missing; it always appears. The space comes instantly. When any one says 'twenty-nine dollars,' my mind goes immediately to the twenty-nine in that space. I cannot transpose the numbers, and a number never seems out of place. I cannot put seven where sixteen is, nor move forty to where thirty is. I seem to have no control over the arrangement of the whole series, nor over any number in the series. If I try to look down the right side of the thirties or the forties, my mind does not seem able to view them in that relation at all."

"I put thirty a little higher than thirty-one, and forty a little higher than forty-one, and so on throughout the remaining groups. Thirty is the lowest one in that incline; it occupies the lowest plane. Thirty-one is seen lower than thirty, dropping a little, but *is* higher, being on the incline. Thirty is about on a level with twenty-nine. I never think of looking past thirty-nine to forty. Forty never gets in the way of thirty-nine, the latter being a little lower than the former."

"Forty is higher than any in the twenty series. The numbers from forty-one to forty-nine are just the same in their relations to each other as the numbers in the thirty series. Forty-nine is just as much higher than thirty-nine as forty is higher than thirty, both series having the same inclination. The fifty series is higher than the forty, the same as five is higher than four. The sixty series is below the fifty quite decidedly; I think it is below the forty. I cannot compare the elevations of thirty and sixty. I think I can look at the fifties and the sixties from either side. If I were not thinking about t. I might be able to tell better. Seventy is to sixty just about seven is to six being lower. The seventies are much lower n seven, the lowest point in the entire form being seventy-en. Fifty-five is the highest number. Eighty is a little higher than seventy, and ninety is a little higher than eighty. I look upon one to twenty-nine, the thirties, and the forties from the left side, and on the nineties, eighties, and seventies from the right side of the series. The fifties and sixties seem to be almost directly in the line of vision."

"The numbers seem to occupy spaces, which I would represent by a parallelogram, measuring about $\frac{5}{8}$ths by $\frac{1}{16}$th inches for the larger numbers, and $\frac{3}{8}$ths by $\frac{1}{16}$th for the smaller numbers."

A time-test revealed that the successive numbers "rose" in the mind very rapidly. Viewing each number successively from one to one hundred, omitting none, required an average interval of only twenty-eight seconds. A similar test on a number of adults without any number form required intervals varying from seventy-three to ninety-two seconds. The subject required thirty-two seconds to count the whole series, that is, mentally saying the words while following the numbers. This proved to be the approximate average for the other adults.

"Whenever I perceive a number written on the blackboard, I see it in this series if it is below one hundred. I never confuse the numbers on the board with the numbers in my mind. I cannot read a newspaper account containing numbers less than one hundred so rapidly as not to see the numbers in the form. If, on the other hand, I wanted to remember a special thing, such as in shopping, if I wished to buy two spools of silk and five yards of ribbon, I would not use these mental numbers in any way. They would not help me to remember. Whenever a mistake is made in change, for example, the series never helps me out. Once I could remember numbers in general statistics quite well, but not now. I was always very quick and accurate in arithmetic, and learned it very fast."

"I have not noticed any tendency on the part of the form to change during the last few years. In fact, it is permanent, and could not change. In thinking of thirty, or forty, I would not feel uncomfortable if all the other numbers were missing. These are in their places, and the others will come up if needed. The series has never in any way bothered me by standing out in its entirety, or by any inability to get rid of the numbers. It never interferes with my attention. It has never been any source of wonder to me, always seeming perfectly natural. I have a faint impression of thinking about it, or being conscious of it four years ago. I may have come across something like it in my reading. I have never attempted to analyze it in any way. The last few days have tended to make the plan clearer, and I have learned many things about it (the subject being a member of a class in psychology). Should a number less than one hundred fail to appear in its place when I am thinking of it, I should feel much surprised. It is perfectly agreeable to me to have this form."

"I can always see it better with my eyes shut. If I try to picture it and cannot get the relations right, I close my eyes and then I can get the detail very readily. I dream a great deal, but I do not remember that the form has ever appeared in my dreams. I also find it impossible to construct any image and place it between the numbers and myself. I do not have much trouble in getting images of things, except that when reading descriptions of places in books, I cannot see the places."

Within four months after the above descriptions were given, the subject discovered that it was possible to enlarge and to contract the form at will. In either instance of change, the proportions of the geometrical relations did not vary. No dream experience in the interval which involved the form was reported.

II. The Day Form.

In addition to the form for numbers, this subject has a tri-dimensional form into which the days of the week are placed. This is a relatively simple form, lies near in front and extends to the left. The time direction is from right to left. It starts with Sunday, which is always the first day of the form (see diagram III), close to the mental point of regard. This day is to the right, and nearly on a level with the eye, but must be looked up to slightly. Monday is to the left of the direct line of vision, "quite a space above, and a little higher than Sunday." Monday is the highest day of the week. Tuesday is about as far beyond Monday as the latter is distant from Sunday, but "goes below Sunday." Wednesday descends slightly, while Thursday ascends "a little bit higher than Wednesday." Friday "is very low down, being the lowest day." Friday evening is the lowest part of the week. "A straight line connecting the evening and morning of Friday, if continued, would pass through the point of regard." Saturday "rises from Friday up towards the *next* Sunday," which is not quite so high as the first Sunday.

This form is always of "the present week." It can be repeated for one or two weeks in the future, when it is projected farther to the left, until it becomes dim and fades away. One or two weeks just past can be arranged, or "thought of," in the same form, when they are added on towards the right of the Sunday with which the series begins. The past days begin to fade away at the end of one or two weeks. The present week is the staple and recurrent form.

The names of the days of the week appear in print, as it were, filling spaces lying at right angles to the time-line, which marks the general forward direction from right to left. These names appear as "dark spaces," with but little illumination, and no coloring. As in the case of numbers, they seem to be parallelograms of uniform dimensions. The days seem to be distinct from the nights, the latter being represented by the darker spaces between the former, which are equal throughout the form. The forenoon of a day is usually "seen" as either the nearer portion of the *time*-line occupied by that day, or by the portion of the *day*-line below the time-line. The afternoon is "seen" as either the portion of the time-line to the left of the day-line, or the upper half of the day-line itself. The subject has no preferences among the days.

An interesting fact connected with this form is, that, while the names of the days were known ("learned") before the subject could read, it never occurred to the person that use was being made of this form until the Sunday before the statement of these descriptions, in August, 1899. On that day the report ran thus: "I wondered how I would look on Wednesday (that is, how Wednesday would appear); but I had to wait until Wednesday actually came." It became a new experience to get the days "all together," and to connect the facts. This implies that the visualization had a definite dependence upon the actual perception of time as filled in with the associative aid of the name given to a particular portion of time.

III. THE MONTH FORM.

The months comprising the current calendar year are arranged by the subject into a form, which is distinct from the form for the days. In relation to the latter, the month form is "located" farther away from the mental point of regard, and in a position more nearly at right angles to the line of vision (see diagrams II and III). This form also is tri-dimensional. "The months seem to rise to the left. January is farther away than the days of the week, and a little below the horizontal plane passing through the point of regard. February is higher, and March is still higher, April descends, while May is the highest month in the entire year. June, July, and August are each a little lower than its predecessor. September, October, and November ascend, in each instance, slightly above its predecessor, while December goes down toward the next January. At New Year's the form starts anew." The spaces between the months seem equal. "August, the present month, is seen permanently to the left."

The name of each month does not seem to lie at right angles to the time-line. The time direction, as in the day form, is towards the left. "The first few letters of the name of the month seem to cover the first few days of the month, but tending towards the right, the remaining letters swing off towards the right of the time direction, while time moves to the left." In the case of the longer names, it is usually the ordinary abbreviation of each name which appears, such as "Jan.," "Sept." The shorter names appear in full.

This form is always of "the present year." The months of the past year can be localized by special effort. "A year ago this month is localized by stepping back from the January of the form to December, November, and so on, to August, towards the right. This process can be continued for about a year previous to the first January, when fading takes place." The next year can be constructed in a similar manner, *mutatis mutandis*, by beginning with December and proceeding to the right.

The subject has preferences for some of the months and aversions towards others. May seems especially agreeable, while December is not liked in the least (that is, the months in the form). There is "always a feeling of relief when December has passed." These associations are regarded by the subject as due probably to later experiences, derived from reading and observation.

It should be noted that the direction of time in the day and month forms moves from right to left, conforming to the general group direction assumed by the number form, instead of from left to right, the usual way of placing successive days and months in an occidental calendar, for example.

IV. CHARACTERISTICS OF THE SUBJECT.

The following biographical data are added for such light as might be thrown upon the genesis of these three forms of visualization. The subject possessing these forms is an unmarried woman, thirty-five years of age at the time of the first descriptions. She was born in Hamilton, Ontario, being the seventh child in order of birth in a family of twelve children, whose parents were natives of Ireland. Four children died in infancy. The father had been a school teacher before immigrating to America. Her home was in a country district until her ninth year. Her playmates were her brothers and sisters and a few children from the neighboring farms. As a child she "was always shy and timid, committing many childish misdeeds, and always afraid of punishment." No early experience of fright or strain in early years stands out distinctly in memory. She was delicate in health until the age of ten, but does not recall any special illness at any time; there was no marked trouble with her eyes in childhood. Since her fourteenth year her right eye has been astigmatic, and the left eye myopic, both defects having been corrected by wearing proper glasses during the last few years.

The subject first attended school about three months before the ninth year of age. "I was noted in those times for having a good memory. They never said anything about the meaning of words, and I had great trouble in learning words at school; but I could always get my arithmetic lessons." She liked number work, especially when a child, "better than anything else," because she had the satisfaction of having this work right in contrast with language exercises. She learned to read very rapidly, covering the first, second, and third readers in one year. Writing was first taught her in the ninth year, but she was able to make figures long before she could write, or read writing.

The number series is remembered distinctly as fully formed at the age of eight years. The multiplication tables were learned at that time, but the ability to count was acquired at a very much earlier age. The older children of the family were taught at home, and she recalls overhearing her brothers at their work. Thus she became able to count to one hundred before the eighth year. There is no memory of being taught to count (except the drill work in class, where the exercise consisted merely of the repetition of the names of the numbers), but there is a memory of having learned to count before the sixth year. The acquisition of the multiplication table is distinctly remembered. The table was printed, as usual then, in full in the text-book. At that time the numbers, when thought of, were placed in the proper spaces in the number series. In multiplying two by two, four was always thought of as now, the thought being of the product and not of the factors. The subject has experienced no particular liking or disliking for special numbers, except three, which was once made with a distinct pleasure. The formation of the figure 3 was very difficult until the age of fourteen, when the ability to make the figure was acquired by diligent and assiduous practice.

The names of the days of the week were learned *previous* to learning to read. The names of the months were first known *after* having learned to read. The scheme for the months is remembered as having been acquired later than the scheme for the days. (This fact does not essentially discredit the report above, that the form for the days was not fully thought over until the time of special description.) In motor abilities, there is no disposition on the part of the subject to be left-handed. This fact may have some negative significance with reference to the feature of all the forms to proceed to the left. It was also ascertained that two of her senior brothers possessed number forms. No details of the elder's form were known; the younger's number form was known merely as being much more complex than the one possessed by the subject.

THE GAMBLING IMPULSE.

By CLEMENS J. FRANCE.

The present study is an attempt to investigate the origin and nature of the instincts and motives involved in chance plays and gambling. The writer has followed the biological or genetic method approach, calling upon the facts of biology, anthropology and history as aids in the solution of the problems encountered. The historical side has been especially emphasized as the writer has had in mind the ethical and sociological value of a contribution to the subject of gambling, as well as the psychological. From this point of view the historical aspects appealed to the writer as being of especial significance.

The writer takes great pleasure in expressing his thanks to President G. Stanley Hall who has been throughout the investigation a constant source of inspiration as well as of assistance. He also wishes to acknowledge the aid of Professor E. C. Sanford in giving much valuable criticism both as regards the form and content of the work, of Dr. Alexander Chamberlain in suggesting literature, and of Mr. L. N. Wilson, the Librarian of Clark University, in procuring a number of rare and valuable books.

Section 1. Historical. Gambling seems to be indigenous among all races. There is evidence of its antiquity both in Egyptian paintings and in materials of undoubted genuineness found in the tombs of this same people; among whom the practice was even attributed to the gods.[1] Evidence of the extent and danger of the habit is given from the fact that a man convicted of gambling in Egypt was condemned to work in the quarries.[2] Certain gambling games of the Chinese and Japanese are said to have been invented by the Emperor Yao, 2100 B. C.[3] Gambling among the ancient Hindus, Wheeler tells us, became a madness. There are certain Hindu legends of Rajahs, playing for days in succession, until the loser is reduced to the condition of an exile or a slave.[4] Among the ancient Persians gambling was a common diversion. Plutarch in his life of Artaxerxes relates that Queen Parysates, the mother of the younger Cyrus, at one time "used all her skill in gambling to satiate her revenge and accomplish her bloodthirsty projects against the murderers of her favorite son."[1] The prohibitions in the Koran are unable to suppress the practice among the modern Persians.[2] History furnishes examples of people risking their lives on a single throw of the dice. St. Ambrose informs us that this was common with the ancient peoples, especially the Scythians. He also tells of how the Huns were ready to play at all times, even when at war; that they always carried their dice with them, guarding them as they would their arms.[3] There is not much evidence that the ancient Jews ever gambled, except by drawing lots.

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[1] Ashton: History of Gambling in England, p. 3.

[2] Steinmetz: Gaming Table, Vol. I, p. 57.

[3] Ashton: *ibid.*, p. 4.

[4] J. Talboys Wheeler: The History of India from the Earliest Days, Vol. I, pp. 175-185. London, 1868.

This practice was very common, and we know that the "promised land" was thus divided. Disney tells us that, in later days, the Jews did gamble and that gamesters were excluded from the magistracy, and were incapable of being chosen into the greater or lesser Sanhedrin; and that they could not be admitted as witnesses.[4]

"In China," says Huc, "gaming is prohibited and yet is carried on everywhere with almost unequalled passion. . . China is, in fact, one vast gaming house. . . . . The games are very numerous. They play day and night, till they have lost all they have, and then they usually hang themselves."[5] Williams says "Gambling in China is universal. Hucksters at the roadside are provided with cup and saucer, and the clicking of dice is heard at every corner. A boy with but two cash prefers to risk their loss on the throw of a die, to simply buying a cake without trying the chance of getting it for nothing. Gambling houses are kept open by scores by paying bribes to the officers."[6]

In ancient Greece, also, gambling prevailed to a large extent. Philip of Macedon favored the practice, recognizing its corrupting influence on the Greeks. Aristotle ranked gamblers with thieves and plunderers (Ethic ad Nicomachum, lib. IV), and the Athenian orator, Callistratus, speaks of the desperate gambling in vogue. (Xenophon Hist. of Greece, lib. VI, C. III).[1]

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[1] Steinmetz: *ibid.*, Vol. I, p. 57.

[2] Steinmetz: *ibid.*, Vol. I, p. 59.

[3] Jean Barbeyrac: Traite du Jeu, 3 vols. Amsterdam, 1737. Tom. 11, p. 345.

[4] John Disney: A View of Ancient Laws Against Sin, Morality and Profaneness. Camb, 1729. Quoted from Ashton: *ibid.*, p. 5.

[5] Huc: Chinese Empire. Quoted from Rouge et Noir, Gambling World, p. 35-36.

[6] S. Wills Williams: The Middle Kingdom. New York, 1900. Vol. I, p. 825.

Evidence of extensive gambling at Rome is derived from the excavations of Pompeii and other places. "Sig. Rodolfo Lanciani says that, so intense was the love of the Roman for games of hazard that whenever he had excavated the pavement of a portico, basilica, bath or any flat surface, accessible to the public, he always found gaming tables engraved or scratched on the marble or stone slabs."[2] Ashton writes: "Notwithstanding the laws against it, there was hardly in Rome a more common or more ruinous pastime."[3]

Steinmitz devotes a chapter to the gambling amongst ancient Roman emperors.[4] Augustus was passionately addicted to the practice, and even gloried in his character of a gamester. Caligula stooped even to falsehood and perjury at the gaming table. "The Emperor Claudius played like an imbecile and Nero like a madman." Nero would stake 400,000 sestertii (£20,000) on a single throw of the dice, and Claudius had the interior of his carriage arranged so that he could gamble on his journeys. Domitian was also an inveterate gambler. Juvenal, the contemporary of this emperor, writes: "When was the madness of games of chance more furious? Now-a-days not content with carrying his purse to the gaming table, the gamester conveys his iron chest to the playroom. It is there you witness the most terrible contests. Is it not madness to lose one hundred thousand sestertii and refuse a garment to a slave perishing with cold?"[5] The rage at Rome seems to have kept on increasing until "finally at the epoch when Constantine abandoned Rome never to return, every inhabitant of that city, down to the populace, was addicted to gambling."[6]

That the ancient Germans were devoted to this form of play Tacitus testifies. They would not only stake all their wealth, but also their liberty.[7] In modern times, it was in Germany where there existed the most celebrated gambling resorts of all Europe—Baden-Baden, Ems, Hombourg, Aix-la-chapelle, Wiesbaden. It was to these resorts that the wealth and nobility assembled during the 'cure-season.' "Princes and their subjects, fathers and sons, and even, horrible to say, mothers and daughters, would hang side by side, for half the night, with trembling hands and anxious eyes watching their chance card." [1]

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[1] Steinmetz: *ibid.*, Vol. I, pp. 59-61.

[2] Ashton: *ibid.*, p. 7.

[3] Ashton: *ibid.*, p. 11-12.

[4] *Ibid.*, Vol. I, Ch. IV.

[5] Satire 1, 87. *Cf.* Steinmitz, Vol. I, p. 67.

[6] Steinmetz: *ibid.*, 1, p. 68.

[7] De Moribus German, Cap. XX, 14. Quoted from Jean Barbeyrac Traitè du Jeu. Tom. II, p. 342-3.

The early French annals record that the 'haughty and idle lords were desperate gamblers,' and that the exercise of this impulse formed their chief occupation. In the reign of Charles VI, who himself gambled heavily, we read of the Hotêl de Nesle—famous for its terrible gaming catastrophies. 'Gambling went on in camp, and even in the presence of the enemy. Generals after having lost their own fortunes compromised the safety of their country.' Play among the lower classes was not excessive at this time;[2] but under Henry IV, every one seemed to catch the frenzy, all professions and trades being carried away by it. Magistrates sold for a price the permission to gamble. An Italian, a professional gambler, Pimentello, made 100,000 pounds in the course of a year; and there was scarcely a day but some one was ruined. The result of this state of things, says Steinmitz, was incalculable social affliction. All this gambling took place in the face of the most stringent laws against it.[3] In the reign of Louis XIII the passion was pretty well suppressed, but in that of Louis XIV the practice prevailed in high circles, and as the king and queen regent both played, every one who had an expectation at court learned to play cards. Steinmetz says: 'Before this, there was something done for the improving of conversation; every one was ambitious to qualify himself for it by reading. But on the introducing of gaming men likewise left off tennis, billiards and other games of skill, and consequently became weaker and more sickly, more ignorant, less polished, more dissipated. . . The women, who till then had commanded respect, accustomed men to treat them with familiarity by spending the whole night with them at play. . . . . At the death of Louis XIV three-fourths of the nation thought of nothing but gambling.'[4] Dusaulx writes: "I have found cards and dice in many places where people were in want of bread. I have seen merchants and artisans staking gold by the hands full. A small farmer has just gambled away his harvest, valued at 3,000 francs."[5] In the reign of Louis XVI the passion prevailed unabated, and was undoubtedly increased by the French revolution. At this time gambling was a source of not a little revenue to the government.

The English have always been notable for their propensity to gamble; a writer familiar with the visitors at Monte Carlo says that the majority are English.[1] Hence we are not surprised to find that the use of dice in England is of great antiquity, dating from the advent of the Saxons, Danes, and Romans.[2] Ordericus Vitalis (1075-1143) tells us "that clergymen and bishops are fond of dice playing," and John, of Salisbury (1110-1182) calls it the damnable art. An edict of 1190 shows that gambling was common among the lower classes; also in the 13th and 14th centuries we have evidence of its prevalence.[3] Cotton in his "*Complete Gamester*" gives a vivid description of the practice in the time of Elizabeth. And Lucas in his "Lives of Notorious Gamblers," gives proof that high play was common in the reigns of Charles II, James II. William III and Queen Anne.[4] Legislation against card playing was made in the reign of Henry VIII, prohibiting the common people from playing except at Christmas.[5] A book entitled "The Nicker Nicked, or the Cheats of Gaming Discovered" (1619), furnishes a good account of the gambling house of that period. The author says: "Most gamesters begin at small game; and, by degrees, if their money or estates hold out, they rise to great sums; some have played first of all their money, then their rings, coach and horses, even their wearing clothes and perukes; and then such a farm; and, at last, perhaps, a lordship."[6]

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[1] Steinmetz: Vol. I, p. 157.

[2] Steinmetz: *ibid.*, Vol. I, p. 70.

[3] Steinmetz: *ibid.*, Vol. I, pp. 78 ff.

[4] Steinmetz: *ibid.*, Vol. I, pp. 87-88.

[5] Dusaulx: De la Passion du Jeu, 1779. Quoted from Steinmetz, Vol. I, p. 105.

In the reign of Queen Anne the evil seems to have increased, especially among the women. Ward in a Satire, "*Adam and Eve Stript of their Furbelows*" (1705), has an article on the gambling lady of that period—entitled—"Bad Luck to Him who has Her; or the Gaming Lady." Steele devoted No. 120 of the "Guardian" (July 29, 1713,) to female gambling, in which he points out the ruinous effects attendant on the indulgence of it amongst ladies. "Nothing," he says, "so quickly wears out a fine face as the Vigils and cutting Passions of the card table. Hollow eyes, haggard looks, and pale complexions, these are the natural indications of a female gamester." He speaks of the danger to the moral nature and purity of a woman who has lost heavily. "She has then only her person
f." Pope, also, in his Rape of the Lock (Canto III)
ure of the gambling lady and of the corrupting in-

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oir: Gambling World, p. 259.

., p. 12.

., p. 13.

Lucas: "Memoirs of the Lives, Intrigues and Comical
the most Famous Gamesters and Celebrated Sharpers
of Charles II, James II, William III and Queen Anne."

., p. 41.

., pp. 45 ff.

fluence that the practice exerts upon her.[1] In the reign of George II the state of affairs continued as in previous reigns. A letter in the Grub Street Journal says, "The canker of gambling is surely eating into the very heart of the nation."

Gambling houses kept by women which had long existed and for a period were closed, were reopened at the end of the 18th century.[2] Gambling at this period was the chief amusement of women, as well as of men. Says Steinmetz: "At social gatherings it was vain to attempt conversation. The intellectual was inhibited by the impulsive. The time presents a picture of dissolute manners, as well as furious party spirit. The most fashionable ladies were immersed in play. The Sabbath was disregarded and moral duties neglected."[3] Seymour Harcourt in his *Gaming Calendar* (1820) gives a vivid picture of the universality of the habit among all classes in the latter part of the 18th century. Gambling clubs, which later played so great a rôle, began now to rise into prominence. Two of these, White's and Brook's, deserve especial mention. "It was at White's Club that play was carried on to an extent, which made ravages in large fortunes, the traces of which have not disappeared at the present day. It was at White's that General Scott won £200,000. It was at Brook's that Charles James Fox, Selwyn, Lord Carlisle, Lord Robert Spencer and other great Whigs won and lost hundreds of thousands. The number of great men who played heavily, the number of fortunes wrecked at this time, is almost incredible."[4] The Duke of Wellington in his early career lost a large sum of money at play, and was on the point of selling his commission to relieve himself from his debts of honor.[5] Duels and suicides caused by gambling were common, as is shown by the Annual Register.

In the early part of the 19th century the passion had not abated. Ashton says: "The west end of London literally swarmed with gambling houses." One writer speaks thus of these gambling hells: "To these places thieves resort and such other loose characters as are lost to every feeling of honesty and shame. A table of this nature in full operation is a terrific sight; all the bad passions appertaining to the vicious propensities of mankind are portrayed in the countenances of the players. . . . . Many in their desperation strip themselves on the spot of their clothes, either to stake against money or to pledge to the keeper of the table for a trifle to re-new their play, and many instances occur of men going home half naked, having lost their all."[1] Crockford's Club was the most noted of all the gambling houses in London. It is estimated that Crockford netted 300,000 pounds in the first two seasons alone. Ashton writes: "One may safely say without exaggeration that Crockford won the whole of the ready money of the then existing generation."[2]

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[1] Ashton: *ibid.*, pp. 55 ff.

[2] Ashton: *ibid.*, pp. 76 ff.

[3] *Ibid.*, Ch. VI, Rise and Progress of Modern Gambling in England.

[4] Ashton: *ibid.*, *cf.* Chapter VI on these clubs.

[5] Reminiscences: 3rd sec. Quoted from Ashton, *ibid.*, p. 99.

The great gambling institution of England is that of horse-racing, or the turf, as it is commonly called. Every one has read of the famous English Derby. To-day, by means of a system of bookmaking, published in the daily papers, every one is enabled to gamble, and the extent of the practice is enormous. In the English Political Science Quarterly of November, 1900, attention is called to the extent and evil of this practice and an urgent plea made for reform.[3]

Brief reference only can be made to the few leading countries remaining. We know that the Russians, Italians, Spaniards and Japanese are all addicted to gambling. Alphonso X, of Castile, endeavored to prevent the practice, by founding in 1332 the Chivalric Order of the Band, in which it was forbidden. A further ordinance was issued by John I, King of Castile, in 1387, forbidding the subjects to play backgammon or dice. In 1506 because of the misery in Italy, arising from the indulgence of gambling, the Council of Ten forbade all forms of this play and all sale of dice and cards. This did not eradicate the evil. Toward the end of the last century gambling raged furiously at Venice. In 1774 the Graded Council ordered the close of a large public gambling house known as the Ridotto. To-day the State lottery in Italy is still in existence.[4]

The United States has not been excelled by the countries of Europe and Asia in their proneness to this form of play. Steinmetz says: "It is not surprising, that a people so intensely speculative, excitable and eager as the Americans, should be desperately addicted to gambling. Indeed, the spirit of gambling has incessantly pervaded all their operations, political, commercial, and social." We cannot go into the history here, but all know well the struggles our large cities have had and are still having to suppress this practice. Nor is it confined to large cities. The excessive gambling among the miners and lumbermen in the West is well known; the notoriety of Saratoga as a

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[1] Frazer's Mag [illegible] 101-206.

[2] *Ibid.*, p. [illegible] III, on Crockford's Club.

[3] Any one [illegible] in history of the English turf is referred to Ashton's [illegible] this and that of Rouge et Noir, Gambling World.

[illegible] p. 40-41. The reader who is interested will find [illegible], Vol. I, Ch. XIV, on the laws against gambling great gambling resort a few years back is still fresh in our memories. A collection of stories by Mr. Lillard will give the reader an inside view of some aspects of the gambling carried on in the United States.[1] Mr. Lillard informs the writer that he has gambled and seen gambling in every State in the Union, and that the stories which he gives are very fair examples of many of his own experiences.

The history of lotteries and an account of the rôle they have played in society is a subject too extensive to be more than touched upon.[2] The lottery existed in ancient Rome and has flourished continuously until comparatively recent times. State lotteries have existed from the 15th century, and have been, in many countries, one of the chief sources of revenue. As an illustration of this, the following facts, of the part lotteries played in our own country, are instructive. MacMaster tells us that in 1790 cash had become so scarce that it was impossible to obtain money to pay the cost of local governments or to carry on works of public improvement, and that in consequence recourse was had to lotteries. "In a short time there was a wheel in every town large enough to boast of a court house or a jail. Wherever a clumsy bridge was to be thrown across a stream, a public building enlarged, a schoolhouse built, a street paved, a road repaired, a manufacturing company to be aided, a church assisted, or a college treasury replenished, a lottery bill was passed by the legislature, a wheel procured, a notice put in the papers, and often in a few weeks the money was raised.

It was the money collected from the sale of lottery tickets that Massachusetts encouraged cotton spinning, and paid the salaries of many of her officers, that the city hall was enlarged in New York, that the court house was built at Elizabeth, that the library was increased at Harvard, that many of the most pretentious buildings were put up at the Federal City. The custom, indeed, continued for several years, and the State wheel became as regular an item in the papers as the ships news or prices current."[3]

The following is a list of some of the lotteries and their purposes, collected at random by MacMaster from the newspapers for the year 1788-9: West River Bridge Lottery, Brattleborough, Vt.; Furnace Lottery, Fair Haven Iron Works, Vt.;

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[1] Poker Stories, edited by J. F. B. Lillard. Francis P. Harper, publisher, 17 East 16th Street, New York.

[2] The reader is referred to Vol. I, Ch. XIII, in Steinmetz. To the Gambling World, by Rouge et Noir, Ch. VIII, for excellent accounts of lottery. Many excellent references may be obtained from Poole's Index.

[3] MacMaster: History of the People of the United States, Vol. I, pp. 587-8. New York, 1883.

Windsor County Grammar School Lottery, Vt.; Mass. Semi-Annual State Lottery; Leicester Academy Lottery, Mass.; Hartford Bank Lottery, to build a bank along Connecticut River at Hartford; Bell Lottery, to procure a bell for the German Reform Church (Maryland); Petersburgh Church Lottery (Va.); Alexander Lottery, to pave certain streets; Fredericksburg Academy Lottery (Va.); Lottery to enable the Hebrews to pay the debt on their synagogue (Penn.); Lottery to build a city hall at Philadelphia; New York City Lottery to enlarge the city hall for the use of Congress.

The result of this was very injurious to industry and business, as a general rage for speculation arose among all classes. MacMaster says: "Farmers and artisans, tradesmen and merchants were neglecting their businesses to watch the drawings of innumerable wheels."[1] In 1817 lotteries still existed. "The lotteries were almost as bad as the dram-shops and tippling-houses. The depression and excitement, that so invariably followed the drawing, diverted the laborer from his work, weakened his moral tone, consumed his earnings, and soon brought him to pauperism."[2]

To realize the extent of gambling in Europe at the present time a few facts about the expenditure of the greatest of modern gambling resorts, Monte Carlo, are instructive.[3] The expenditure of the Casino runs into gigantic figures; for police and courts the administration pays per annum £20,000; for roads £8,000; for lighting and water £19,000; for clergy and schools £9,000; for maintenance of the Casino, including salaries, management, gardens, lighting, heating, etc., £800,000; for charity £6,000; for carnivals and prizes £11,000; for printing £2,000; for agents, pensioners, etc., £9,000; for the viaticum £12,000; for the reptile press £25,000; for theater and orchestra £40,000; an expenditure of upwards of £1,000,000. And yet the shareholders received in 1897 dividends to amount of £570,000. During 1891 the total revenue from the tables was a little over 23,000,000 francs. The dividends paid average about 38 per cent.

In closing this brief historical sketch the writer gives the following list of persons of note who have been especially addicted to gambling.[4] Guido, the great painter, Voiture, Montague and Des Cartes in early life, Cardan, Lords Halifax, Anglesey and Shaftsbury, Lord Carlisle, Selwyn, Charles James

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[1] [illegible] II, p. [illegible]

[2] [illegible] p. 529.

[3] [illegible] Rouge et Noir's chapter on Monte [illegible] pp. 254-5.

[4] [illegible] from Steinmetz's chapter on Gambling [illegible], Wits, Statesmen. Vol. II, Ch. XI.

Fox, Wilberforce, Pitt, Sir Philip Francis, Horace Walpole, Marie Antoinette, Nell Gwynne. Webster and Clay, according to Lillard, were both great poker players.

Anthropological. The passion for gambling is nowhere so strong as among savage and barbarous races. The American Indians are the most desperate and reckless gamblers in the world. Some of them will not only lose all their possessions, but also will stake their wives and children and even their own liberty. The practice is thus a cause of much distress and poverty[1] in their families. Property changes hands with the greatest rapidity, a single throw at dice or a heat in a horse-race, often doubling the player's forture or sending him forth an impoverished adventurer.[2] Among the Nahua nations the great national game is one played with a ball—the end being to throw the ball through a small opening—a feat seldom done except by chance. The successful player, Bancroft tells us, was made as much of, as the winner at the Olympian games. All classes gambled heavily on the issue. Among the Hurons the chief game is that of the dish (jeu du plat).[3] "Large parties assemble to play this, during which the people not only lose their rest, but in some measure their reason. The players appear like people possessed, and the spectators are not more calm. They all make a thousand contortions, talk to the bones, load the spirits of the adverse party with imprecations, and the whole village echoes with howling." The game is in great repute as a medicine, the gambling parties often being ordered by the physician. The people all convene in a hut, the sick being brought in on mats.[4] Among the Iroquois whole townships, and even whole tribes, play against each other. The assemblage would last sometimes eight days, meeting every day, every inhabitant of each township tossing the dice once.[5]

The Senecas had a popular belief that a certain gambling game would be enjoyed by them in the future life of the Great Spirit—which was an extravagant way of expressing their admiration for it. Among the Zuñis 'kicked stick' (Ti-kwa-we) is the great national game, and is indulged in from boys of five to men of forty. Every one, man, woman, and child, takes sides and gambles on the issue.[1] In many tribes women are as much addicted to this practice as men, and among some there are games peculiar to the women alone.[2]

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[1] Bancroft: Races and Peoples, Vol. I, pp. 113-114; 123, 219; 244; 353; 517; 587. *Cf.* also a paper by Stuart Culin, Chess and Playing Cards. Smithsonian Report, 1896. pp. 665-942.

[2] Stevens in Pac. R. R. Rep., Vol. I, pp. 404, 412. *Cf.* Bancroft,Vol. I, p. 281, footnote.

[3] Bancroft, II, pp. 299-301.

[4] P. de Charlevoix: Journal d'un Voyage dans l'Amerique. Septrionnale, Paris, 1744, III, p. 257. Quoted by Stuart Culin, "Chess and Playing Cards." Smithsonian Inst. Rep., 1896. pp. 721-2. Brebeuf: Relations de Jesuites, Relation du l'annee, 1636, Quebec, 1858. p. 113. Quoted from Stuart Culin, *ibid.*, p. 722.

[5] Morgan: League of the Iroquois, Rochester, N. Y., 1851. Quoted by Culin, *ibid.*, p. 726.

Gambling is the chief recreation of the Malays of Sumatra, all classes indulging extensively in play. They risk high stakes on their success; in some instances a father will stake his wife or children; or a son, his mother and sisters.[3] The Battas are also passionate gamblers. "They do not hesitate to risk all they possess, and often stake their own person, and if unable to pay are sold as slaves.[4] The Javanese,[5] Balinese,[6] Sulus,[7] Bugis,[8] are all addicted to the practice. The ancient Mutsams were inveterate gamblers, the gambling crowd being called together by the sound of the drum.[9] So also the Patagonians are much devoted to gambling, the women as well as the men risking their valuables.[10] Among the Usbegs, a nomadic people of Central Asia, the favorite game is the Ashik (*ahsek*—ankles bones of sheep) "played in the manner of European dice, and with a degree of passionate excitement of which one can form no idea."[11] So we find mention of gambling all over the world—among the Melanesians, Malayans, Alaskans, Koreans, Hawaiians, African Negroes, in Brazil and in all the Latin Republics; amongst the natives of South America, amongst the natives of the Isle of Man, and even amongst the Icelanders.

The extremes, to which the gambler in his passion is led, are almost incredible. "It is well known that they have eaten up cards, crushed the dice, broken the tables, damaged the furniture, only to end in fights with each other."[12] We have record of a man who, enraged at play, jammed a billiard ball into his mouth, where it stuck fast until removed by a surgeon,[13] of one who, having put a candle into his mouth, chewed and swallowed it;[1] of a mad player at Naples, who bit the table with such violence that his teeth went deep into the wood, and who thus remained, nailed as it were, until he expired.[2] Steinmetz[3] gives cases where loss at play resulted in stupefaction—some players neither knowing what they did or what they said; of a case of a man who cut off all the fleshy part of one of his ears to obtain money to play; two cases of men who, having tossed for each other's money, tossed to see which one would hang the other, the loser actually submitting to be hanged.[4] Jean Barbeyrac cites a case of a man, who having gambled all his life, made in his will an injunction that his skin and membranes be used to cover a table, a dice box and draught board, and that dice be made out of his bones.[5] Archdeacon Bruges mentions a similar case. There are a number of examples of men who have staked their wives.[6] Parchasus Justus, who wrote a book to cure himself of the habit, tells of people who staked their teeth and eyebrows. Hyde found some Chinamen who staked the fingers of their hands; Schouten,—of Chinamen who staked the hairs of their heads.[7] A gambler has told the writer he has seen a man shot in a game of poker, and thrown into a corner, while the rest continued the play.

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[1] J. G. Owens: Pop. Sci. Monthly, XXXIX, pp. 39-50.

[2] Culin: *ibid.*, 751-4; Bancroft, *ibid.*, I, p. 244. Col. R. S. Dodge, thirty-three years among our wild Indians, pp. 325-333.

[3] A. Featherman: Social History of the Races of Mankind, Second Division, London, 1887. p. 302.

[4] A. Featherman: *ibid.*, Second Division. Malao-Melanesians, p. 325.

[5] A. Featherman: *ibid.*, p. 382.

[6] A. Featherman: *ibid.*, p. 404.

[7] A. Featherman: *ibid.*, p. 416.

[8] A. Featherman: *ibid.*, p. 448.

[9] A. Featherman: *ibid.*, Third Division, 1890, p. 16.

[10] A. Featherman: *ibid.*, Third Division, p. 489.

[11] Arminius Vámbéry: Sketches of Central Asia, London, 1868, p. 110.

[12] Steinmetz: *ibid.*, II, p. 50 ff.

[13] Steinmetz: *ibid.*, II, p. 52.

Col. Mellesh was asked what were his feelings when he entered the battle of Vermeira. "Precisely the same," he replied, "as those I used to feel when laying a tremendous stake at Maco."[8] Hon. Gen. Fitzpatrick once said: "If I could coin my heart and drop my blood into drachms, I would do it to play, though by this time I should probably have neither heart nor blood left."[9] It is not an uncommon thing for ruined gamblers to go and sit up night after night watching the play of others. Voltaire cites a case of an old woman, ruined by gambling, who offered to make soup gratis for the players provided she might look on the game.[10] Cotton in his "Compleat Gamester" writes of the passion as follows: "Gaming is an enchanting witchery, gotten between idleness and vice; an itching disease, that makes some scratch the head, whilst others, as if bitten by a Tarantula, are laughing themselves to death; or, lastly it is a paralytic distemper, which seizing the arm, the man cannot chuse but shake the elbow. It hath this ill property above all other vices, that it renders a man incapable of prosecuting any serious action, and makes him always unsatisfied with his own condition; he is either lifted to the top of mad joy with success, or plunged to the bóttom of despair by misfortune; always in extremes, always in a storm; this minute the gamester's countenance is so serene and calm that one would think that nothing could disturb it, and the next minute so stormy and tempestuous that it threatens distruction to itself and others; and, as he is transported as he wins, so losing, is he tost upon the billows of a high swelling passion, till he hath lost sight of both sense and reason.[1] La Placette[2] says: "In order to conceive clearly the state in which the soul of the gambler finds itself, it is not sufficient simply to represent a sea always agitated; it is necessary to imagine that these agitations come from five or six opposite vents, which rule, each in its own course in such a way, that there is not one of them, which has not the advantage many times in the quarter of an hour." Barbeyrac writes: "I do not know if there is any other passion which allows less of repose and which one has so much difficulty in reducing." He cites anger as a passion of excessive violence, yet one which does not endure long in intensity; likewise ambition, and love. Each of these has its moments of cessation and decrease in intensity. "But the passion of gambling gives no time for breathing; it is an enemy which gives neither quarter nor truce; it is a persecutor, furious and indefatigable. The more one plays the more one wishes to play; one never leaves it, and with difficulty, one resolves to leave off a little while from dice and cards to satisfy the needs of nature; all the time he is not playing, the time seems to him lost; he is tired (ennui). When he does anything else; it seems that gambling had acquired the right to occupy all his thoughts. . . . . Old age far from diminishing the ardor of this passion only results in re-enforcing it."[3] Steinmetz writes: "The gamester lives only for the sensation of gaming. Menage tells us of a gamester who never saw any other luminary on the horizon but the moon. St. Evremond says: 'All the rays of the gambler's existence terminate in play; it is on this that the center of his existence depends. He enjoys not an hour of calm serenity. During the day he longs for night, and during the night he dreads the return of day.' "[4]

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[1] Dusaulx: De la Passion du Jeu. *Cf.* Steinmetz, *ibid.*, II, p. 54.

[2] Gazette de Deux Point, du 26, Novembre, 1772. Quoted from Steinmetz, *ibid.*, Vol. II, p. 53.

[3] *Ibid.*, II, p. 54 ff.

[4] Annual Register, 1812.

[5] Traité du Jeu, Tom. II, p. 338-9.

[6] Barbeyrac: *ibid.*, Tom. II, 342 ff.

[7] Barbeyrac: *ibid.*, Tom. II, p. 345.

[8] Frazer, 16, p. 16, Article, Anatomy of Gaming.

[9] Steinmetz: *ibid.*, I, p. 300.

[10] Steinmetz: *ibid.*, I, p. 66.

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[1] Cotton: Compleat Gamester (1674). Quoted from Ashton, *ibid.*, pp. 1-2.

[2] Traité des Jeux de Hazard, Ch. VII, p. 225 (or Ch. IX, p. 91 second Ed.) from Jean Barbeyrac, Tom. II, p. 236.

[3] *Ibid.*, pp. 336-38, Tom. II.

[4] Steinmetz: *ibid.*, Vol. II, Ch. III.

Section 2. In order to obtain data in regard to the tendency to run risks in every day life the following syllabus was circulated:

TOPICAL SYLLABUS.

PSYCHOLOGY OF UNCERTAINTY.

I. Are there times when you desire to risk something, take chances—materially, socially, spiritually; have an impulse to act in total ignorance of consequences? State frequency and strength of such impulses. Describe any case in your life when you have so acted. State your feelings when you had given in to the impulse. If result was good, how affected? If bad, how? Effect on future acts? In taking risks have *you* been more successful or unsuccessful as a rule?

II. Give any case where of two or more possible lines of action you have chosen one off hand and trusted to chance, *e. g.*, in deciding on a school or college, profession, how to spend vacation, or any decision of major or minor import in which you were actuated more by impulse than from data. State your feelings after the decision, *e. g.*, satisfied or dissatisfied, worry or relief, determination to act decreased or increased. Give any instance in your life where such an impulse to act and trust to chance has interfered with thinking out, or working out, to its end, some uncertain matter. Do such impulses influence you to decide or act before looking at the matter from all sides? Do you ever come to a decision by tossing up a coin?

III. Describe your habits of action in little affairs such as going out without rubbers, coat or umbrella, sitting in draughts, taking chances of its not raining or your not catching cold. Describe a case of person who acts thus habitually—saying "Oh I 'll be all right." Give case of opposite type who runs no risks, wants insurance and security in everything.

IV. Do you like to know far ahead what you are going to do or what is going to happen? Do you make certain definite arrangements very far ahead, *e. g.*, as to how spend vacation, etc.? Is desire to be uncertain dependent on whether you feel cheerful and hopeful, or despondent melancholy? If so, which? Name any things you would prefer to be certain about. Some—uncertain. How about future state after this life? In this life?

V. Do you ever have idea of putting aside a certain portion of your income to devote to speculation? Describe any case in your own experience or in that of another speculating. Did stick to limit set? Win or lose? Effect in either case on conduct, *e. g.*, general bearing toward fellows, future speculation. If lost was he unconsolable, indulging in self pity?

VI. (a) Give a case of person—continually and by nature lucky. One of person who imagines himself lucky. Cases of opposite. Are you as a rule lucky?

(b) Are there days when you get up in the morning and feel: To-day I will be lucky? How are actions affected, *e. g.*, act bolder, more likely to venture? Give a specific case—your general state of feeling, any previous events acting as a cause, etc.

(c) Give any instance in which winning at a game of chance, being successful after having run a risk, encouraged you in your exertions or led you to undertake what you lacked confidence for previously. If you do not remember any case, state feelings in general following the success of an uncertain undertaking.

(d) Comment on your feelings of safety when going on cars or water, running risks of any kind. Do you dislike being cautioned to be careful? What is the effect of such caution?

VII. (a) In hearing about "breaking bank at Monte Carlo" or of some lottery did you ever have the thought come—"I believe I would be the one to break the bank or win the prize?" Comment on your feelings here. Is there a tendency, you have to guard against, to venture on lottery schemes and the like? Have you ever gambled in any form whatever or even made believe you were gambling?

(b) Do you ever have idea that some day things are coming your way, something going to turn up? Comment.

In all 443 returns were received. Of these 70 were males; 340 females; in 33 cases the sex was not given. The answers fall within three groups. (1) A group in which the subjects have frequent and strong impulses to break away from their daily routine and enter on some venturesome undertaking. In this group is found a fairly strong habit of risking. This comprises about 18.6% of the whole number. (2) A group in which subjects are extremely cautious and feel strongly averse to taking any risk. This group comprises 12%. (3) A group wherein there is exhibited no marked inclination or disinclination to run risks; in this group the subjects often enter upon risky undertakings with a certain degree of enjoyment, but are as apt not to take the venture as to take it. In small affairs they are not over cautious, but in large ones, where much is to be lost or won, they hesitate to venture; and unless the object to be gained is something greatly desired they choose not to run the risk. This group comprises 69.4% of the whole. There were 238 cases cited, or nearly 58% of subjects who frequently took risks in small affairs, as going without rubbers, etc. There are 115 cases, or 28%, where caution was exhibited in these small affairs. In the remaining 24% taking risks or exercising caution depended on the mood. In 224 cases caution from some other person was much disliked. In 52 cases no dislike of being cautioned was felt. In 64 cases being cautioned made more reckless, and in 29 cases the subjects did the thing they were cautioned against. In 75 cases subjects are influenced to be more cautious because of failure in their previous risks. In 91 cases subjects are influenced to be more venturesome because of success in previous risks, and in 24 cases subjects even when successful are inclined to be more cautious because of the worry, fear and strain. There were 121 cases where subjects decided affairs off hand, that is they trusted to chance rather than reasoning over the matter in all its aspects. There were 111 cases where tossing a coin or the like was resorted to as a means of deciding small affairs. There were 107 cases of persons who had gambled more or less, and
sons had made believe gamble. Of
answered as to whether they be
ful or reverse in taking risks—
successful; 53 less.

The following is an enumeration of some affairs decided off hand:

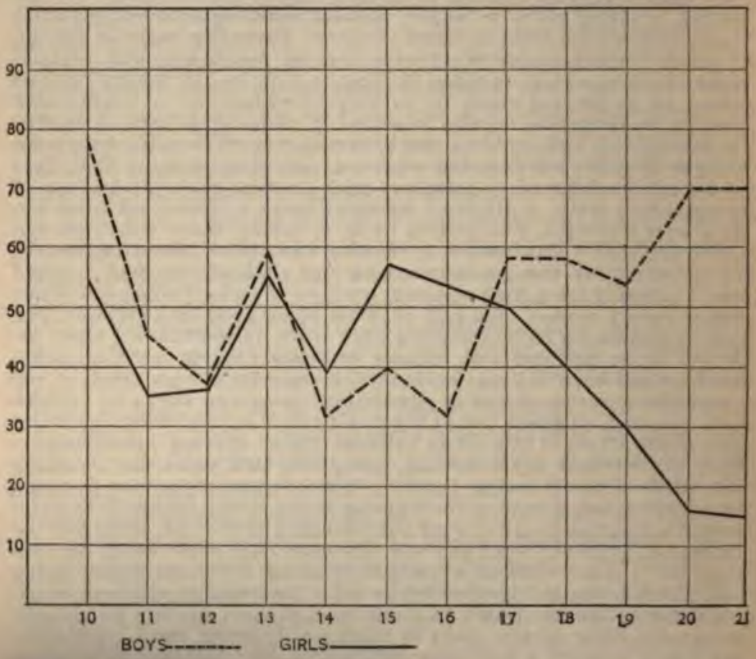
In deciding on the advisability of going to a certain place as an entertainment, etc., 56 cases; in choosing a school, 25 cases; in deciding on the manner of spending one's vacation, 20 cases; in choosing a profession, 8 cases; in buying a dress, 6 cases; in deciding on a course of study, 4 cases; in choosing between two schools to teach, 2 cases; neglecting bad eyes, 2.

Below is an enumeration of some common risks taken:

Entering a class unprepared, hoping not to be called, 72 cases; taking chances at fairs, betting, 29 cases; going to places which are forbidden, trusting not to be caught, 25 cases; entering on an outing when weather threatens, rain or storm, 19 cases; breaking rules of school, 17 cases; tossing penny or drawing lots to decide who will perform some obnoxious task, 15 cases; skating on thin ice, 10; taking risks on water, 10; in playing cards, 10; in bicycle riding, 10; in buying articles, 10; wearing thin dresses in winter, 7; running in front of trolley car or wagon, 6; risking being late to catch a train, 6; crossing dangerous bridges, 4; going out in a bad storm, 4; smoking, trusting that they would not be detected, 3; going out with a severe cold, 3; take risk of being met at train, 3; driving a fractious horse, 2; going out when visitors were expected, risk getting back, 2; taking horse when did not know whether it was needed, 2; running the risk of offending friends, 2; neglecting bad eyes, 2; one each—kissed a friend who had typhoid fever; jumping from high window; went on a rickety toboggan slide; risked losing dinner; took risk of ticket being good on a certain train; removed brace on teeth; climbing high trees; delayed taking train expected to be met on; took chance of succeeding in a school other teachers had been failing in; rode a horse who always tried to run away; doing daring things in gymnasium; man who works in Turkish bath goes out on street late at night with only a towel about his loins; rode horse afraid of cars along railroad track; driving horse down a steep hill without any breeching; going out, risk some one's coming who am desirous of seeing; jumping from a fast moving train; jumping from high trees; dropping from beams in the barn; diving into water from high spring board or over over-hanging trees; risk being late for recitation; go to see some one at a distance, risk their being in; cutting out a dress without a pattern, trusting it will be right; going away from home and leaving babies with the younger children; wearing sister's clothes; climb in dangerous places; starting on expeditions with little money; risks in business, trusting men know nothing about; crossing a high long railroad bridge; walking on slippery logs across water; wear new dress in rain to party; coasting on a dangerous, forbidden hill at night; in case of sickness do not send for doctor; entered upon a normal course without assurance of assistance; stopped a runaway team hitched to a bindery, but had to run in front of the knives; riding on an engine; jumping off and on moving cars; ing a wheel.

arrive at some further knowledge in regard to the ten-
take chances, especially among boys and girls about
f adolescence, the following question was given:
two days vacation was offered you, and suppose I
th two slips of paper in my hand, a long slip
and said, 'If you draw the long slip, instead

of two days, you can have three, but if you draw the short slip, instead of two days, you can have only one. You are free to draw or not. Will you draw?" All question of the moral right or wrong in drawing was, as far as possible, eliminated, also those cases in which the student preferred the short vacation to the long one. In all 776 answers were received from students, ranging from 10 to 22 years of age; boys, 370; girls, 406. Of these, 176 of the boys answered yes, 194, no; and 183 of girls answered yes; 223, no. These figures tell little, but the following curves, showing the answers by ages, are of interest.



Though these curves have little scientific validity, due to the [illegible] the numbers, yet they present certain interesting [illegible] features. The fact that the boys' curve rises, as [illegible] those of maturity, we believe to be in line with [illegible] thesis of the male being the more icono- [illegible] and venturesome element, while the fact, [illegible] girls falls, is, on the other hand, in line [illegible] thesis, that woman is the conservative and [illegible] It is interesting to note that the boys' curve [illegible] 14, 15, 16, that period which coincides [illegible] of puberty, a period in which we know that feelings of uncertainty, vague fears, etc., are rife. At 17 the boys' curve takes a rapid rise. So with girls at the ages 11, 12, and 14, the curve is low—being at 14 at its lowest point—after which it takes a sudden rise, being at its highest point in years 16, 17, 18. We know that after the dawn of the adolescent period there is a great rise in feelings of self-confidence, power, etc. This may account for the curve being at a high point at this time with the girls, and also the sudden rise of that of the boys at 17. The girls' curve being high at 13 may be in an apparent contradiction to these suggestions; however it may be that these girls already had past the period of storm and stress, incident on the dawn of adolescence.

Inadequate as the above data are in point of number, range of age and sex, and trivial as they appear, they nevertheless are of much suggestive value. The solution of the problem of why certain people are inclined to run risks, why they have so strong a belief in their luck, has not a little light thrown upon it by considering these trivial circumstances. We see how strongly they influence future actions and feelings—a little success often raising up a great wave of confidence, a little failure causing great caution and fear. The feeling is far out of proportion to the stimulus. The fact is that we are playing on the two great hereditary chords—fear and faith, as regards personal safety—each of which in turn controls our actions. It is these slight circumstances which exercise and give growth to these factors, and if each man were constitutionally inclined, neither strongly towards the one or the other, the one of these excised the most, *i. e.*, the weight thrown on the fear side or faith side, according to failure or success, would grow most rapidly, until by little increments of success or failure one would find himself an optimist or a pessimist—with strong belief that the powers of the universe were for or against him. But probably no two start out with equal endowments of the hereditary faith and fear instinctive tendencies. The whole matter seems to center about these two pivots—faith in self—and distrust of self. On the one side we have the man who enjoys taking risks, who says he is, as a rule, successful; who thinks he is lucky; that something, some day, is coming his way; who is careless in little affairs of health, has strong faith that he will be admitted to heaven, and in general feels he is a "Glückskind." On the other, the opposite who is always cautious, and fearful, who, even when successful in taking risks, cares not to take them again because of the worry and strain; who is a little uncertain about heaven, and is inclined to think that he is unlucky and never had an idea of anything occurring in his favor.

The conditions, under which the impulse to take risks arises, are of interest, as it seems to occur when the affective curve of pleasure-pain is at it highest or lowest point—in a state of extreme good feeling or bad, when either joyful or sorrowful, when fatigued; one case when the person felt she was about to fail in something. There seem to be two especial ends in view—one the love of an uncertain state of mind and the charm of danger, with the resulting mental and bodily tension and suspense; the other a semi-unconscious yearning toward the "Ground" of things, to get a clue to my relation thereto—am I lucky or unlucky? to get a conviction of safety, a play upon the two instinctive factors of action and passion —faith, and fear.

Section 3. Psychological theories of the gambling impulse are few in number and inadequate in treatment. What little the writer has found is summed up in the following. Steinmetz gives these points: (1) A desire for a stimulus to call forth the natural activity of the mind; indolence, vacuity—being the cause. (2) Love of wealth. (3) It intensifies and gives rise to such feelings as vanity, curiosity, surprise.[1] Another writer[2] says that the passion is due (1) "to avarice—as promising either a vast accession of wealth, or a short road to the possession of it;" (2) to a deficiency in what in physics is called a stimulus.

Ribot, speaking of plays and games in general, says: "This last item (games of chance) alone might prove a tempting one to a psychologist. It has a quasi-passive, somewhat blunted form which Pascal called a diversion (that which turns aside, distracts), a way of pretending to work, or filling up the blanks in existence, of 'killing time.' It has an active form, the gambling passion whose tragedy is as old as humanity, and which is made up of attraction toward the unknown and hazardous, of daring, emulation, of the desire for victory, the love of gain, and the fascination of acquiring wealth wholesale, instantaneously, without effort. These and other elements show that in play, as in love, it is complexity which produces intensity."[3]

A writer in the Spectator[4] takes up arms against those who attribute the impulse to avarice. (1) "No really avaricious person ever gambles, for the pain of paying his losses overcomes both the pleasure of the game and the pleasure derived from winning." (2) "Nor is gaming a mark of inner effeminacy, of a desire for excitement to be gained without exertion." He cites Bismark and Count Cavour, men of the greatest energy—addicted to high play. (3) "Nor is the gambler at heart a cheat." (4) "The true temptation is the desire which prompts most men to drink hard,—love of excitement, a desire to forget self and be rid of the monotony of the common place." Apropos of the above is the observation of Drähms, who says: "The professional gambler is prodigal and generous, especially toward those in distress, and for religious and moral purposes."[1]

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[1] *Ibid.*, Vol. I, p. 24.

[2] Nimrod: Anatomy of Gaming, Frazer's Mag., Vol. XVI, pp. 9-24.

[3] Psychology of the Emotions, New York, 1897, p. 31, footnote.

[4] Spectator, Vol. LXVI, p. 286. "The Gambling Instinct."

Prof. Lazarus's treatment[2] contains the following points: (1) The state of tension (schweben) is sought; avarice being entirely subordinate. (2) Hope and fear are dominant states—with especial emphasis on hope. He thinks the state lottery partially justifiable because it gives the poor people something to hope for. "Man can live without pleasure, but not without hope." (3) Gambling satisfies the positive attraction for danger, present in many men. (4) It satisfies the feeling that we are lucky; emphasizes the efficacy of the idea of Fate in overcoming the idea of blind chance; is the abandonment of reason and giving oneself up to superstition.

Mr. Thomas, in a paper in the American Journal of Sociology,[3] gives some interesting points in regard to the gambling instinct. He bases the instinct primarily on what he calls the conflict interest, which will be best understood by quoting his own words: "There could not have been developed an organism, depending on offensive and defensive movements for food and life, without interest in what we call a dangerous and precarious situation. A type without this interest would have been defective and would have dropped out in the course of development." That this interest prevails, he considers "a sign of continued animal health and instinct in the race." Thomas also lays stress on the desire to get rid of routine,—pointing out that those professions in which there is an element of work and uncertainty, are more popular and more often chosen, as competitive business, the stock market, the learned professions; and among the less intelligent—the callings of policemen, firemen, detectives, livery stablemen, barkeepers, barbers. He sums up: "Gambling as a means of keeping up the conflict interest, and of securing all the pleasure-pain sensations of conflict activity with little effort and no drudgery; and, incidentally or habitually, it may be a means of securing money." He believes—"the instinct is born in all normal persons. It is one expression of a powerful reflex, fixed far back in animal experience. The instinct is, in itself, right and indispensable, but we discriminate between its applications." He holds that the gambler by profession is often of a high type of man—intelligent, and not degenerate. There is no special gambling type; at worst, he is but representative of a class of men who have not been "weaned from their instincts."

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[1] The Criminal, New York, 1900, p. 119.

[2] Prof. M. Lazarus: Reize des Spiels, Berlin, 1883, pp. 58-88.

[3] Vol. VI, pp. 751-763. The Gambling Instinct, W. I. Thomas.

In the following the writer attempts to analyze the factors involved. His conclusions are based on questioning and correspondence with some twenty gamblers, on personal observations in gambling resorts, on a large amount of literature, historical and descriptive, on an analysis of over a hundred stories of gambling, written by gamblers,[1] and accounts of the lives ot gamblers.[2]

The psychic attitude toward uncertainty—the state of suspense—is the most natural starting point.

Prof. Lazarus says: "The pleasure in all chance plays consists fundamentally in suspended activity; in dice, roulette, and faro, nothing of more importance can be discovered than the mental tensity because of the question: 'Will it be seven or eleven; a little or a great number?' This 'oder' (either—or) is a mighty psychological force, an irresistible attracting magnet."[3] We have here curiosity and something added—the feeling of expectation in which, as Wundt says, we outrun the impressions of the present and anticipate those the future will bring, and if the result is postponed there arises strained expectation, in which the muscles are held tensed like those of a runner awaiting the signal for the race, although very possibly the impression demands no motor response whatsoever.[4]

When the stake is added there arises all the pleasure of pursuit with increase of intensity, for as Bain says: "An element of uncertainty increases the interest of pursuit by making it more exciting; . . . . absolute certainty unduly relaxes the bodily and mental strain that is needed for the maximum of gratification."[5] "The purest form of pleasurable excitement," says Sully, "is afforded by a set of circumstances which opens up a number of possible issues though we have not the knowledge to determine which is most probable."[6] We have here ideal conditions for arousal and imagination.

A case is reported of a man who for many years was a spectator at one and the same table without participating in the play. A dispute arising, he was asked to make a decision, as he must know best the laws of the game. He replied that he did not know the game; that he had only looked on to observe where the best cards fell.[1]

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[1] Curtis: Queer Luck; J. F. B. Lillard, Poker Stories, New York, 1896, pp. 231; Clarence L. Cullen, Taking Chances, New York, 1900, pp. 269.

[2] Especially the "Lives" of Lucas, *ibid.*

[3] Reize des Spiels, p. 59.

[4] Lectures on Human and Animal Psychol., London, 1897, p. 376.

[5] Emotions and Will, London, 1899, pp. 220 ff.

[6] Sensation and Intuition, p. 298, *cf.* Bain, *ibid.*, p. 222.

At any gambling table, where it is permitted, you will observe spectators watching with strained attention to see where the wheel will stop or which card will turn up. The writer has found it difficult to leave such a table after standing a few minutes merely to observe what number will win next. In any uncertain event there is the same attracting force, and although one may have no interest in either side, there is always a tendency to speculate on the outcome. This constitutes a large part of the philosophy of life, resolving the uncertainties into certainties. George Eliot writes: "So absolute is our souls' need of something hidden and uncertain for the maintenance of that doubt and hope and effort which are the breath of life, that if the whole future were laid bare to us beyond to-day, the interest of all mankind would be bent on the hours that lie between; we should pant after the uncertainties of our one morning and of our one afternoon; we would rush fiercely to the exchange for our last opportunity of speculation, or success, or disappointment, we should have a glut of political prophets, foretelling a crisis or a no crisis, within the only few hours left open to prophecy."[2]

The race has been evolved in an environment of uncertainty, and it may be that such an environment has thus become indispensable. It cannot be doubted that the state of mental tension, of being on the alert with ears pricked and nose in the air, is a factor of high selective value. We have reason to believe that this state of expectation not only links together and sets in a condition of unstable equilibrium motor centers, but also that in the higher association centers there is a preparatory condition produced. On this assumption the metabolism of both brain and body would be increased, and consequently the potential efficiency of the given moment. Not only reflex action and muscular co-ordination, but also memory, imagination, and judgment times would be quickened. Is it not thus that a condition of uncertainty holds the mind in a tonic and unrelaxed condition? As evidence that, as we approximate a dead level certainty, we tend to lose in mental efficiency, we have the case of the arrested development of the Chinese. It is significant in the case of the Chinese that the passion for uncertainty, having no exercise in the serious side of life, shows itself in the form of play—they being the greatest gamblers in the world. It is then this need of mental tension, this "either—or" state, which is one of the chief factors in chance games and gambling.

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[1] Lazarus: *ibid.*, p. 58.

[2] The Lifted Veil. In Silas Manner. Clerical Tales. p. 190. Hurst and Co.

The addition of the stake brings in a whole train of added states centering about the feeling of power. Hope and fear, joy and sorrow—are especially predominant. It is significant to note that hope must at the moment of action predominate over fear—a necessary biological condition of all action in uncertainty. Again in connection with this playing power, we find arising emulation, aggression, the instinct of domination, with the love of humiliating one's opponent, much allied to the bullying and teasing tendency, pugnacity—with all the resulting emotions.[1] Jealousy and envy are especially strong in the mind of the loser. In the great American game—Draw Poker—the battle element is especially predominant. It is here also that the "bluff" plays so great a role—the attempt to beat your opponent by sheer boldness and self-confidence. The psychic effects of this are significant. It makes the man who bluffs play better and the opponent play worse. The psychic effects of the bluffer in every day life only need to be mentioned.

There are many minor factors indispensable to the success of the gambler,—the cultivation of a calm and passionate demeanor in moments of crisis, never displaying any emotion or hesitancy; the ability to recover quickly from defeat; being ever vigilant and attentive; acquiring the habit of studying your opponent most closely; few men being better "sizers up" of men than the gambler; a sufficient degree of caution tempering your boldness; the learning how to bear sanely good fortune, as well as bad. These fit closely the essentials of any active, exploiting life. But for its costliness and dangers, no better education for life among men could be devised than the gambling table—especially the poker game.

The phase of gambling known as betting is important. The practice is very ancient. At one time in England it became a mania.[2] It has its basis in the tendency to make dogmatic statements on the outcome of uncertain events and the strong inclination to throw your lot in with one possibility. Dr. Small in his monograph on certainty, in which he showed the tendency to make strong assertions regarding certain events, only stated half the truth. The whole history of partisanship, dogmatism and fanaticism is in point, for these are but an out-crop of this tendency plus some interest at stake. Its simplest form is the "I'll bet you" one hears a dozen times a day. A man often will take either side, but after backing one he is apt to believe in it. The wide pedagogical and ethical bearings are evident.

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[1] The reader is referred for a more lengthy account of the battle element to Mr. Thomas's article, Gambling Instinct, Amer. Jour. of Sociol., Vol. VI, pp. 751 ff.

[2] Early part of the 18th century, *cf.* Ashton, *ibid.*, chapter on Betting.

The possibility of getting something for nothing, and that quickly, is another of the salient features in gambling. It is the basis of the stock exchange, of many exploring expeditions, the explanation of such phenomena as the Keeley motor, the Miller syndicate, Mrs. Howe's bank, the Rev. Mr. Jernegan's scheme of obtaining gold from sea water, etc. The credulity of people in the presence of such frauds is most wonderful. This speculating tendency has two or three times in the course of history manifested itself in an extraordinary degree. Two of these, the South Sea Company, better known as the South Sea Bubble, and John Law's Mississippi scheme, all but financially wrecked England and France, respectively.

John Law, who in 1817 was in control of the French finances, issued bonds on large tracts of land along the Mississippi River. The paper was in the shape of stocks, bearing interest. The scheme worked so well, Law issued a second large amount. The whole French people went mad in speculating. McKay[1] says: "People of every age and sex and condition in life speculated on the rise and fall of these bonds. . . . . There was not a person of note among the aristocracy, except the Duke of St. Simon and Marshall Villars, who was not engaged in buying and selling stock. Gamblers with their roulette tables reaped a golden or rather a paper harvest from the throng." Wood says: "The frenzy prevailed so far that the whole nation—clergy, peers and plebians, statesmen, princes, nay, even ladies, turned stock jobbers."[2] It is worthy of note that Law was a Scotch adventurer, and had been for many years a gambler.[3]

About the same time in England the South Sea Company began to sell stocks, claiming the company had rich lands in the South Seas, and promising enormous dividends. McKay writes: "It seemed as if the whole nation had turned stock jobbers. . . . . The inordinate thirst for gain affected all ranks of society. . . . . Besides the South Sea, innumerable other companies started up everywhere. There were nearly a hundred of these projects or bubbles—extravagant to the last degree, yet the people were hypnotized by the craze of speculation. . . . . It has been computed that nearly chapter let us glance at some of the phases of those psychic manifestations which we will group under the term luck.

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[1] Memoirs of Extraordinary Delusions, Vol. I, p. 14.

[2] J. P. Wood: Memoirs of John Law, Edinburg, 1824, p. 14.

[3] H. D. Adams: Under Many Flags, New York, 1896, p. 174, *cf.* also Wood, *ibid.*

Father Lalemont,[1] in describing gambling among the Indians, tells how they prepare for the game: "They pass the night in shaking to find who is most adroit in spreading out their charms and exhorting them. They abstain from their wives, fast, sleep in the same cabin,—all this to have a lucky dream. Everything they dream would bring them luck is brought to the game in bags. They also bring to the game any old men who are supposed to have charms. When the game begins every one sets to praying and muttering, ... with gestures and violent agitations of the hands, eyes and entire face, all for the purpose of attracting good fortune to themselves and exhorting their particular spirits to take courage and not let themselves be worried. Some are appointed to utter execrations and make contrary gestures for the purpose of forcing bad luck upon the other side and frightening the familiar spirits of the opposite party." This is a typical example among many to be found in the anthropological literature.

Richard Proctor[2] gives the following five things that gamblers hold: (1) Gamblers recognize some men as always lucky—as always "in vein."[3] (2) Gamblers recognize those who start on a gambling career with singular luck, retaining that luck long enough to learn to trust in it confidently, and then losing it once and for all. (3) Gamblers regard the great bulk of their community, as men of varying luck—sometimes "in vein," sometimes not; men, who if they are successful, must, according to the superstitions of the gambling world, be most careful to watch the progress of events. If men will not withdraw when they are not "in vein," gamblers believe they will join the crew of the unlucky. (4) There are those, according to the ideas of gamblers, who are pursued by constant ill luck. If they win in the first half of the evening, in the last half they will lose more. (5) Gamblers recognize a class who, having begun unfortunately, have had a change of luck later, and have become members of the lucky fraternity. This change they ascribe to some action or event. For instance, the luck changed when the man married, his wife being a shrew; or because he took to wearing waistcoats; or because "So and So," who had been a sort of evil genius to the unlucky man, had gone abroad or died. Then there are especial phases in the belief in luck. Some believe that they are lucky on certain days in the week, unlucky on others. The skillful whist player, under the name of Pembridge, believes that he is lucky for five years; then unlucky for five years, and so on. Bulwer Lytton believed that he always lost at whist when a certain man was at the same table, or in the same room, or even in the same house." Mr. Proctor considers this belief in luck to be "the very essence of the gambling spirit." Robert Houdin gives the following maxims which he obtained from a gambler. The first three deal with the kind of game a man should play, that he should be calm and cool and not play for pleasure:

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[1] Culin: *ibid.*, p. 722.

[2] Luck: Its Laws and Limits, Longman's Magazine, Vol VIII, pp. 256-269.

[3] The term "in vein" is difficult to translate. If a man is "in vein," luck favors him and he is sure to win. When he loses it is thus always attributed to luck.

(4) A prudent player should put himself to the test to see if he is "in vein." In all cases of doubt you should abstain. (5) There are persons constantly pursued by bad luck. To such I say—"Never play." (6) Stubbornness at play is ruin. (7) Remember that fortune does not like people to be overjoyed at her favors, and that she prepares bitter deceptions for the imprudent who are intoxicated by success. Mr. Houdin sums up: (8) "Before risking your money at play you must deeply study your 'vein' and the different probabilities of the game.[1]" The following is a typical case of the superstitious gambler: "This man believed that his clothes had an influence on his luck. If luck followed him he would wear the same clothes whether they were adapted to the weather or not. The same man believed in cards and seats. He objected to any one making a remark about his luck. He had the strongest objections to our backing him. He was distressed beyond measure if any touched his counters. His constant system of shuffling the cards was at times an annoyance. This was a great card player."[2]

Miss Bergen[3] found the following superstitions to be current among gamblers and card players: (1) If your luck is poor walk around your chair three times, lift it, sit down, and your luck is secured (Gen'l in U. S.). (2) It is bad to play against the grain of the table (Gen'l in U. S.). (3) It is unlucky to turn up your hand before the dealer is through (Alabama). (4) It is common to blow on the deal without looking at it for good luck (Providence, R. I., and Salem, Mass.).

A's pet aversion is a man who puts his foot on his chair. He says, "When I tilt my chair back and find a foot on the rung I feel like swearing, as I know I am hoodooed for that round anyway." *B* will not play with a man standing behind him looking over his hand. *C* puts his stockings on wrong side out to bring him luck. Such cases as these might be multiplied indefinitely.

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[1] Les Tricherres des Grecs devoiles. Quoted from Steinmetz, *ibid.*, Vol. II, 253-259.

[2] Knowledge: Vol. I, p. 223.

[3] Current Superstitions, p. 79.

Rouge et Noir[1] gives the following superstitions common among gamblers: "To turn your back on the moon when playing for money portends ill luck; to lend money is unlucky; to play on borrowed money is unlucky; playing with money first laid on the altar Christmas night is lucky; some gamblers believe they can cheat luck by going from table to table, or playing at certain intervals. Beau Brummel believed that a crooked sixpence brought him luck and that, on losing it, his luck deserted him (Raikes Journal). In Germany the rhyme—

Lirurn, larum, broom sticks hot,
Aged women eat a lot.

written on a piece of parchment and kept in the gambler's pocket, was supposed to enable him to win large quantities of gold. In 1897 little China or golden pigs were treasured as fetiches to bring luck. The approach or touch of a hunchback is held to be a sign of luck. In London about Throgmorton Street (the paradise of stock brokers), there used to sit a man with a bag of nuts into which passers by thrust a hand, and if they guessed correctly the number, they would be paid a penny for each, if wrong, the guesser paid a penny. Many a speculator regulated his 'bulling' and 'bearing' by his successful or unsuccessful dip into the bag." Rouge et Noir continues, by giving some of the superstitions of Chinese gamblers.

The forms which this belief takes—such as, for example, belief in seats, clothes, etc., may be largely accounted for by association. I lost two or three times when such a person was in the game; losing becomes associated with him. Further, a generalization is made on this basis from one or two particular cases. Prof. Jastrow in a very interesting paper shows, also, that many of the forms of belief, and of superstitious practice, have their basis in the crude form of reasoning by analogy;[2] the clover on account of its trefoil form, suggesting trinity, is good against witches; the ill luck of thirteen and Friday—being probably due to religious associations, etc. This only explains why certain things come to have a lucky significance attached. It does not explain the belief itself. Let us consider this larger problem.

Prof. Stewart Culin, in a most comprehensive study,[3] finds that the implements of gambling of primitive man have their origin in methods of divination, and gives many cases where the same methods and implements are used, now for gambling, now for divination. The following abridged abstract from Prof. Tylor shows the same facts. He points out that divination by lot was a branch of savage philosophy of high rank; though with us it is a mere appeal to chance, it was not so with them. It was to no blind chance that appeal was made when Matthias was chosen by lot to become the twelfth apostle, or when the Moravian Brethren chose wives for their young men by lot, or the Maories when they threw lots to find who among them was the thief,[1] or the Guinea negroes' appeal to the bundle of little leather strips in the hands of the priest;[2] or the Greeks, the ancient Germans,[3] the ancient Italians[4], or Modern Hindus when they left decisions, etc., to be determined by lot.[5]

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[1] Gambling World, pp. 29-32.

[2] Fact and Fable in Psychology Ch. Natural History of Analogy, pp. 236-274. Boston and New York, 1900.

[2] Chess and Playing Cards—Catalogue of Games and Implements for Divination exhibited by Natural Museum in connection with Atlantic Exposition, 1895. Smithsonian Report, 1896, pp. 665-942.

"The uncivilized man thinks that lots or dice are adjusted in their fall with reference to the meaning he may choose to attach to it, and especially is he apt to suppose a spiritual being, standing over the diviner or gambler, shuffling the lots or turning up the dice to make them give their answers. This view held its place firmly in the Middle Ages, and later in history we still find games of chance looked on as results of supernatural operation." Thomas Gataker in a work "Of the Nature and Use of Lots" (1619), shows that this view prevailed at that time. Jeremy Taylor, forty years later, seems to give credence to the view.[6] Tylor points out the vitality of this notion of supernatural interference as illustrated in the still flourishing art of the gamblers magic and the folklore of the day. "Arts of divination and games of chance are so similar in principle that the very same instrument passes from one use to the other. . . . . . In the Tonga Islands the cocoanut is now spun to see if a sick person will recover, now spun for amusement.[7] In Samoa the spinning of the nut was formerly used as an art of divination to discover thieves, but now they only keep it as a way of casting lots and as a game of forfeits.[8] . . . . . The connection between gambling and divination is shown by more familiar instruments.[9] The huckle bones or astrali were used in divination in ancient Rome, being converted into rude dice by numbering the four sides, and even when the Roman gambler used the "tali" for gambling he would invoke a god or his mistress before the throw. . . . . . "The Chinese gamble by lots for cash and sweetmeats, whilst they also seriously take omens by solemn ap- [illegible]o lots, kept in the temple, and professional diviners sit in the

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h: Vol. I, p. 220.

n: Guinese Kust Letters Eng. Trans. in Pinkerton, Vol. 9.

: Germania 10.

Dic. of Gr. and Rome; art, oraculum, sortes.

s: Oriental Illustrations, p. 163.

y Taylor: Ductor Dubitantium, in works, Vol. XIV, p. 337.

er: Tonga Islands, Vol. II, p. 239.

: Polynesia, p. 214; Williams, Figi, Vol. I, p. 228. Compare nland, p. 231.

ith's Dict., art, 'Talus.'

market place.[1] Playing cards are still used in Europe for divination. If it is a rule to be relied on that serious precedes the playful, then games of chance may be considered survivals in principle or detail from corresponding processes of magic,—as divination in sport made gambling in earnest."[2]

Space will not permit the writer to give here the mass of material that pertains to the belief in luck,—the lucky days, numbers, proverbs, the thousand and one charms and methods of avoiding bad, and bringing good luck. A volume has been written on the horseshoe alone. Suffice it to say that we have to do with a belief that was almost the guiding philosophy of action for centuries, and one that is not yet dead.

Miss Bergen has collected a volume of such beliefs still prevalent throughout the United States. She points out clearly that they are not merely 'survivals,' that these things only survive as long as endures that state of mind which originated them, that as thoughtless habit, such phenomena would not long persist, maintaining that her collection emphasizes the doctrine, that the essential elements of human nature continue to exist; and that "we can see the inclination has not disappeared, however checked by meditation or through complex experience, and however counteracted by the weight of later maxims. The examiner finds that he himself shares the mental state of the superstitious person."[3]

That the belief in luck still prevails was shown by a bit of recent Boston history—the "Lucky Box" craze of February, 1900—initiated by one Henry Parker. Large, conspicuous advertisements appeared for weeks in the daily papers—stating the wonderful powers of the lucky box, giving testimonials of those who had obtained marvellous success after having purchased one. It is estimated that Mr. Parker made seventy-five thousand dollars out of the scheme before his mail was stopped by the post office department, a period of three to five weeks. Though he had originally a plant, turning out a thousand boxes a day, he could not supply the demand. Twenty thousand letters addressed to Parker were held up at the Boston post office. An employee of a big transfer company said that he bought five boxes and enjoyed great luck. He said he knew a man who had won $1,000,000 after he purchased a box.[4]

The following returns, received from college and normal school students, emphasize the same point.[5] In all, 423 answers were received. Of these, 140 were cases of persons who considered themselves lucky by nature; there were 51 cases of persons who considered themselves unlucky; 31 cases of persons who imagined themselves lucky; 27 cases who imagined themselves unlucky. There were 116 cases in which the subjects stated that there were certain days when they felt they would be lucky, and 76 cases in which, Micawber-like, the persons believed something good was coming their way.

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[1] Doolittle: Chinese, Vol. II, pp. 108, 285-7, 384; Bastian, Oestl. Asien.

[2] Tylor: Primitive Culture, Vol. I, pp. 78-83.

[3] Current Superstitions, p. 5, of Introduction.

[4] Boston Herald, March 11, 1900, p. 8.

[5] *Cf.* Topical Syllabus, Question VI.

A typical case or so of the man lucky by nature is instructive:

> (1) "I have an uncle who is lucky. He is of a jolly disposition, seldom worries, and is very risky. He was in the Carl's Rock Railroad disaster, where the train fell down an embankment sixty feet high, and he escaped. He was in the fearful fire in a Brooklyn theater where hundreds of lives were lost, and he escaped. In the Civil War, a shell passed so close to his head that it carried away a small piece of his scalp, but otherwise he was uninjured, while his chum was killed by the very same shell. He was thrown from the cab of a locomotive into the tender, in another railroad accident, and escaped with very slight injuries. He narrowly escaped walking into the elevator shaft of a ten story building. His life has been a constant round of narrow escapes, and he succeeds where nearly every one else fails in both business and social life." (2) "It does not matter what this man does it seems to result in his gain. He can pick up four-leaf clovers nearly anywhere, and has found money and jewelry. If anything is lost he seems to have the power to find it easily. When he goes out gunning he shoots more game than nearly any one else in the crowd. He can find game where others cannot. In business transactions he never makes bad bargains."
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> (3) "There is a man at home who is very lucky. He made a fortune in enterprises along the board walk. Every one speaks of him as the luckiest of men. In three distinct cases after he had sold out his share in certain buildings they have burned down."
>
> (4) "There is a friend of mine, who to my knowledge, has been lucky every day of his life. In speculations of every kind he is always successful, everything he undertakes turns into money."
>
> (5) "I know a man who trusts to fate continually, and he never comes to harm. I'd be afraid to act as he does. One day when the ice in the pond was very thin he walked across the stream, and when somebody told him he would be drowned he said, 'Well if you are born to be drowned you will never hang.' He got over all right, but I do not think anybody else could have done it."

This belief that luck is of an individual nature is one of its
ignificant features. Brand cites a large number of cases,
how fortune attaches itself in a peculiar individual
Tylor gives the following interesting account of this
belief:

> trine of patron, guardian, or familiar spirits has held its
> through all grades of animism. Their especial function
> First, while a man's own proper soul serves him for the

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op. Antiq., Vol. I, pp. 365-367; *cf.* also Dyer: Folklore of
e Under 'Luck.'

ordinary purposes of life and thought, there are times when powers and impressions out of the course of the mind's normal action, and words that seem spoken to him from without, messages of mysterious knowledge of council or warning, seem to indicate the intervention of, as it were, a second superior soul, a familiar demon; . . . . second, while common expected events of daily life pass unnoticed as in the regular course of things, such events as seem to fall out with especial reference to an individual, demand an intervening agent.

"Such deliverances are accounted for in the lower culture by the action of the patron spirit of guardian genius. Among the Watchandi of Australia the spirit of the man first slain by another enters the body of the slayer and becomes his warning spirit.[1] That the most important act of the North American Indian's religion is to obtain his individual patron genius or deity, is well known. In Chili,[2] as to guardian spirits, it has been remarked that every Arancanian imagines that he has one in his service. In Africa,[3] the negro, and in Asia, the Mongol, has his guardian spirit. So also among the Aryan nations of Northern Europe and in Classic Greece and Rome, the doctrine may be traced.[4] In the Roman world the doctrine came to be accepted as a philosophy of human life. Each man had his "genius natalis"—associated with him from birth to death, influencing his action and fate. In early and mediæval Christendom this belief continued to prevail. Luther remarks that a prince must have a greater, stronger, wiser angel than a count, and a count, than a private man. Bishop Bull says: 'I cannot but judge it highly probable that every faithful man at least has his particular good genius or angel, appointed by God over him, as the guardian and guide of his life.'"[5]

The following letter[6] from a man of culture who visited Monte Carlo (and who played only once for the experience) is of value, as it is a faithful introspective account of his feelings on this subject.

"And what was my experience? This chiefly—that I was distinctly conscious of partially attributing to some defect or stupidity in my own mind, every venture on an issue that proved a failure; that I groped about within me for something in me like an anticipation or warning (which of course was not to be found) of what the next event was to be, and generally hit upon some vague impulse in my own mind which determined me; that when I succeeded I raked up my gains, with a half impression that I had been a clever fellow, and had made a judicious stake, just as if I had really moved a skillful move at chess; and that when I failed, I thought to myself, 'Ah, I knew all the time I was going wrong in selecting that number, and yet I was fool enough to stick to it,' which was, of course, a pure illusion, for all that I did know the chance was even, or much more than even, against me. But this illusion followed me throughout. I had a sense of *deserving* success when I succeeded, or of having failed through my own willfulness, or wrong-headed caprice, when I failed. When, as not infrequently happened, I put a coin on the corner between four numbers, receiving eight times my stake, if any of the four numbers turned up, I was conscious of an honest glow of self-applause. I could see the same flickering impressions around me. One man, who was a great winner, evidently thought exceedingly well of his own sagacity of head, and others also, for they were very apt to follow his lead as to stakes, and looked upon him with a sort of temporary and provisional, though partially intellectual, respect. But what quite convinced me of the strength of this curious fallacy of the mind, was that when I heard that the youngest of my companions had actually come off a slight winner, having at the last moment retrieved his previous losses by putting his sole remaining two franc piece, out of the 125 francs he was willing to risk, on the number which represented his age, and gained in consequence thirty-two times his stake, my respect for his shrewdness distinctly rose, and I became sensible of obscure self-reproaches for not having made use of like arbitrary reasons for the selections of the various numbers on which I staked my money. It was true that there was no number high enough for that which would have represented my own age, so I could not have staked on that,—but then, why not have selected numbers whereon to stake that had some relation to my own life, the day of the month which gave me birth, or the number of the abode in which I work in town? Evidently, in spite of the clearest understanding of the chances of the game, the moral fallacy which attributes luck or ill luck to something of capacity and deficiency in the individual player, must be profoundly ingrained in us. I am convinced that the shadow of merit and demerit is thrown by the mind over multitudes of actions which have no possibility of wisdom or folly in them,—granted, of course, the folly in gambling at all,—as in the selection of the particular chance on which you win or lose. When you win at one time and lose at another the mind is almost unable to realize that there was no reason accessible to yourself why you won and why you lost. And so you invent what you know perfectly well to be a fiction—the conception of *some sort of inward divining rod* which guided you right, when you used it properly, and failed only because you did not attend adequately to its indications."

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[1] Oedfield: Aborigines of Australia. In Trans. of Eth. Soc., Vol. III, p. 240.

[2] Molina: Chili, Vol. II, p. 86.

[3] Waitz: Vol. III, p. 182.

[4] Tyler gives many cases and references we are compelled to omit here.

[5] Primitive Culture (1888), Vol. II, pp. 199-204.

[6] Letter to the Spectator, Oct. 24, 1873, Saxon-les-Bains, "A Study in the Psychology of Gambling."

We have here two important factors, one—the very essence of the belief in luck—and especially that phase of the belief represented by guardian angels, etc.,—a semi-conscious feeling of a guiding power which gives one a cue to the result; second, we have an exaggerated feeling of one's own skill. Both of these are closely allied, both have their basis in a feeling of self-confidence, and both are common to men playing games of chance [illegible] tering on chance adventures. These inner feelings or [illegible] ns are very strong in gamblers—the "hunch,"[1] as [illegible] nd, like the inner voice of Socrates, it is followed [illegible] sly.

[illegible] ied to this is the rôle played by the imagination. [illegible] s says: "The particular seductiveness of luck, [illegible] who in winning or losing entice from stake to stake, is 'die Phantasie.' The player hears in roulette the ball rolling, sees it fall and beholds himself a winner—"not as though it were a hope but as a living reality, does he perceive it with the inner eye and ear of the imagination." At first he puts no faith in the inner voice, but later he comes to believe in the phantom and wishes he had trusted in it.

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[1] [illegible] "hunch" is very common among gamblers, and the re[illegible] ess with which this "hunch," or feeling in one of im[illegible] ng success,—is followed,—is very significant.

The above facts, as well as those previously presented in the returns to the questioner, seem to point to one conclusion, viz., that one important element involved, is a strong passion for certainty, a longing for the firm conviction of assurance for safety. The uncertain state is desired and entered upon, but ever with the denoument focal in mind. In fact, so strong is the passion for the conviction of certainty that one is impelled again and again to enter upon the uncertain in order to put one's safety to the test. Thus, if successful, is the conviction of safety fostered and strengthened, and if unsuccessful, more prurient is the desire to try again to attain to success, and thus the general feeling of certitude, a little success tapping the whole hereditary reservoir in which the feeling of certitude lies latent. The feeling is thus out of proportion—either in success or failure to the stimulus. Thus, paradoxical as it may sound, gambling is a struggle for the certain and sure, *i. e.*, the feeling of certainty. It is not merely a desire for uncertainty.

We are here dealing with that same great passion for certitude which is the cornerstone of science, philosophy and religion—the desire to put the element of chance out of the game. We cannot do business with it. Take any game of chance, the player is pitted against a force which is different from a personal opponent. Here is a dark, inscrutable power which decides for or against him. As Lazarus says—the battle in chance games is not one of person against person, I against you; but now a new factor is present. This is *lawless chance* which determines the issue. There is no possibility of measuring the strength of the opponent; no means of estimating whether I will be a winner or loser.[1] It is because of this obscurity, because of the utter impossibility of prevision, that the player feels so utterly helpless before the unknown, in which there is no conception but that of chance as a deciding factor. On the side of chance is all the power and activity; on the side of the player all is impotence and passivity.

Such would be the condition of things when one acts in a game of chance or any chance environment, if there were no other psychic factors entering in to modify this. There is probably no case in which there are not other psychic factors, else a man could scarce bring himself to the point of action. But the equalizing force, which always enters, is that of belief in luck or something akin. It is not blind chance which now decides, but there is a willing power. Lawlessness is put aside for fate, law or will. This is the very meaning of luck, the substitution of a conscious, determining force or will, for an indeterminable, precarious, headless chance,—law in place of lawlessness. The contest now becomes one between the players, each man's luck, against each other man's. It is not now a question of blind chance, but this—do you or I stand better with the deciding power, who wills? This, says Brinton, is the one feature underlying all religions—viz., that the great force of the world is a personal will.[1] This also is the feature which lies deepest in the gambler's consciousness. The attraction toward this dark, inscrutable power, plus a personal interest, is the background motive. One hopes by gripping the very ground of things to obtain the conviction of certitude. It so fascinates, one is impelled to experiment with it, test its relation to his own personality. It is a semi-unconscious desire—one ventures when he could not explain the reason. It is due to this same desire for a feeling of certitude that science, philosophy, religion, and all endeavor have derived one of their chief motives;—to fathom the fascinating unknown—to get the relief—the psychic "let down" from tension, a relief which the feeling of certainty always affords.

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[1] Lazarus: *ibid.*, pp. 73 ff.

The significant fact, however, which the study of the gambler's consciousness, as well as that of men acting in uncertainty in general, impresses upon us is, that the feeling of certitude frequently exists even in a state of great uncertainty.

We see men having the same feeling of surety under the most precarious conditions. The conditions do not allow of prevision, but the subject feels and believes in himself, and in the favorable outcome of events, just as if prevision were possible. This conviction of safety, expressing itself in the more or less definite objective forms of luck, guardian angels, etc., is a definite biological product. Its effectiveness as a force in evolution in the increasing of action, is enormous. It is, we believe, an instinct-feeling as well defined as fear, its direct opposite, and like other similar psychoses, is a result of natural selection. We must remember that the state of doubt, bred by fear is ever and anon present in force—but still the opposite feeling holds its own, and must be in the ascendant at the moment of action. These two states so strongly counteracting each other are intermittent; now one is focal in consciousness, now the other. And this is precisely the economic value of these anthropomorphic forms of belief—as luck totems, ceremonies, and formulas—to hold the faith-state focal.

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[1] Primitive Religions, Ch. I.

We will term this feeling—faith—as directly opposite to fear; using faith in a much larger sense than in its general religious connotation. It has its physiological concomitants—the increase of blood-flow and general vital feeling, and is the underpinning of all such states of consciousness—as those of the gambler who believes that he will win next time, of the lottery player that he will be the holder of the winning number, of the soldier that the other man will be shot, of each of us who believes that he is born under a lucky star; it accounts for those 'inner voices' which tell us to do this or that, and we will win, those voices which led men into the belief in guardian angels, etc.; it also accounts for the gamblers 'hunch,' those strange premonitions— "Do this" or "avoid that;" and the belief in a special guiding Providence.

It is more definite than what we in general term self-confidence. It is the feeling: I have a special tip, a cue in touch with the very ground principle, who wills. It is the natural result in a race which has been evolved in an environment where to succeed and survive ventures and risks were necessary, and where those who did survive had been successful in their risks. Let us consider this.

McGee[1] in a very interesting account takes the position of a two-sided cosmos among animals and primitive man—"the danger side in the van;—the safety side in the rear—with self as an all important center;" and speaking of primitive man he writes: "Only religious adherence to experience shaped instincts enabled his survival and permitted his tribe to increase." Further, he says: "Nearly all animals manifest a constant realization of three overshadowing factors in nature as they know it—factors expressed by danger, safety, self, or by death and life to self, or in general terms the *evil* of the largely unknown, and the *good* of the fully known,—co-ordinated in the vaguely defined subject of badness and goodness; and the chief social activities of animal mates and parents are exercised in gathering their kind into the brightness of the known and educating their native dread of all outer darkness. So, too, the more timid tribesmen . . . . betray, in conduct and speech, a dominant intuition of a terrible unknown opposed through self to a small but kindly known. This intuition is not born of inter-tribal strife—it is merely the subjective reflection of implacable environment. . . . . Over against this appalling evil, there is a less complete personified good, reflecting the small nucleus of confident knowledge with its far reaching penumbra of faith. . . . . A vague yet persistent placement of the two sides is clearly displayed in the conduct of men and animals—the evil side is outward, the good side at the place or domicile of the individual, and especially of the group. . . . In general among the lower and more timid, the back stands for or toward the evil, the face toward the good, and among the higher and more aggressive, the face is set toward danger, *e. g.*; defensively birds and sheep, huddle with heads together, savages sleep with heads toward the fire, and timid tribesmen tattoo talismans on their backs, while litters of young carnivora lie facing in two or more directions, self-confident campers sleep with feet toward the fire, and higher soldiery think only of facing the foe."

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[1] McGee, J. W.: American Anthropologist, Vol. I, No. 4, The Beginnings of Mathematics, pp. 646-674.

The early development of self-confidence and faith no doubt began in some such conditions. Only through the exploiting of this terrible *unknown* could knowledge be acquired and advancement gained. It is thus clearly seen how all variations in men along the line of faith in self, feelings of safety in danger and uncertainty would be of the highest selective value. Men with such a characteristic would in consequence be inclined to take greater risks, and those of them that were successful would be much favored in survival through their newly acquired knowledge. Thus the exploiting type of man with great interest in the unknown, with a feeling of immuneness from harm, with a strong feeling of coming success, was developed. In its early manifestations this feeling of safety was propped and strengthened by its objectification in such anthropomorphic forms as are exemplified in the complex structure of beliefs in luck, favoring deities, guardian angels, etc. The value of this feeling of certitude in an environment of uncertainty cannot be overestimated. It is a biological device to procure from men the greatest amount of activity—a device which takes no account of the safety of the individual. Antipodal to this feeling is that of fear. The two are ever in conflict. Character is largely determined by the relative strength in the individual of each. Every game of chance, every risk which a man runs, is an interrogation of his feeling—a question put to the powers that be, whether or no such a feeling is warrantable. Do I stand in with the deciding will or no [illegible] "No." By being successful one [illegible] warrant, [illegible] that he is lucky [illegible] the de[illegible] is impartial [illegible] lieve in his [illegible] in the fa[illegible]ary, that *he* [illegible] under [illegible] chief encourage[illegible] life—[illegible] that a kindly fate [illegible] self *sui generis* an[illegible] the mighty will behind things is especially behind *him*. To men entering upon great enterprises such a feeling is indispensable. It made a Napoleon—the child of destiny—possible to the world. It also gave the Christian world its Christ.

Montesquieu and Diderot both were of the opinion that the gratifying self-reliance in the feeling that I am a special favorite of fortune,was the one particular motive of hazard plays.[1] For one who does not believe in blind chance, a pure game of chance, or any risk, is the purest form of obtaining an expression from the guiding power, or favor or disfavor. A phenomenon closely allied is the desire to have one's fortune told. It is a very indefinite notion of somehow getting a clue to how I stand in relation to the universal mechanism. This is the central problem in an environment of uncertainty.

Thus we see how closely the gambling impulse approximates the philosophical and religious motive. With the savage, as we have seen, gambling and religion are almost identical. The one chief incentive to the savage for gambling is to see how he stands with his favoring or disfavoring deities. The very implements he uses are developments from divinatory implements and often the same devices are used, now in divination, now in gambling. In deciding any specific case as to whether he will go to war, or as to which direction he shall proceed to forage for food, he trusts to the answer from his deities, as given by the fall of his divinatory implements. Has a theft been committed, his deities reveal the guilty man through the same means. In all fortuitous circumstances he trusts implicitly to these same divinatory means. And with these he gambles in his time of recreation. Is it not clear why gambling is of the most serious moment to him? Now he is not seeking encouragement or direction in a specific case but in a general case. He feels that the fall of these implements, directly guided by the deity, is pregnant with meaning respecting his general status with that being. Thus it is the savage is so desperate a gambler, regarding his whole fortune, aye, even his wives and children as insignificant in comparison with this decision for or against him. So also in a less intense degree is it with the modern believer in luck. This explains much of the almost inaccountable states of emotional frenzy gamblers display, and their tenacity in play.

Lucky or unlucky, that is the paramount issue with them both. No matter how much a man may understand of the calcuus of probabilities, when he sits in the game, like the observer bove quoted, he feels somehow he has in him a divining rod inting the way to success if only he would be guided. The

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Lazarus: *ibid.*, pp. 72, 73.

step to absolute superstition is a short and easy one. Men need sorely the assurance of their being a vital part in the universal economy. Hence the unfailing interest in the transcendent. The philosopher seeks by reason to get a grip on the ground principle; the religious man seeks it by faith; the gambler, by faith strengthened by the favoring fall of the die.

Significant in this connection is the fact that there seems to be a correlation between the extensity and intensity of the gambling passion and the religious life of certain races. Prof. Lazarus, remarking on this, says: "That race which shows the deepest religious development of all races up to the present, that has built up and developed the richest and most sincere spiritual life, the Teutonic, showed in earliest times a passionate inclination toward chance plays. . . . . The property, so clearly conspicuous in the course of the history of the Teutonic peoples for the transcendent, the abstract, and idealistic, shows itself also in the inclination toward those plays in which the idea of fate in dark form and figure is represented. Stern moralists might object to see the highest ideas placed in connection with immoral plays themselves; but psychological facts must be investigated without prejudice where it has to do with tracing back a historically believed universal property in the innate character of a folk spirit."[1]

To realize the enormous rôle which this factor that we have termed faith, *i. e.*, the feeling of safety under circumstances of great uncertainty and risk, has played in the development of civilizations, a glance at one or two significant cases in history is necessary. The Jews in an environment of uncertainty, *i. e.*, wandering in the desert—with this feeling as a basis—created that system of monotheism, which has been adopted by the whole Christian world. As the gambler must have the conviction of safety in his staking in games of chance, and so, on this feeling of faith as a basis, creates the objective forms of luck, etc., so the Jew under the same stress created the most effective of all confidence producing agents—one omnipotent God—*who especially favored him.* In each case the principle is the same—that biological factor selected in the race—to instill confidence in the face of danger, that device to put chance out of the game. So wherever we find men acting under circumstances of great risk, we find this feeling asserting itself. Also it is where this conviction of immunity from danger is especially strong that we find races and individuals of the exploiting type. The Romans had it to an extraordinary degree. And as Tyler says: "In the Roman world the doctrine of guardian angels came to be accepted as a philosophy of human life.

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[1] *Ibid.*, pp. 79, 80.

Each man had his ' genius natalis '—associated with him from birth to death—influencing his action and fate." We have here the backbone of individualism and optimism.

Just as this state of mind was strong in the Jew and Roman —the two great exploiting individualistic races of the ancient world—so it is one of the chief factors in the Anglo-Saxon mind. As a prop to this feeling of certainty and safety, he also has his religion. The Anglo-Saxon race believes as firmly that it is the favored people of the one great God, as the Jew did two thousand years ago. And each individual believes that *he* is especially favored. His faith in his own ultimate safety and good fortune, is something stupendous. If a great gambling enterprise, as in the case of the Philippine Islands, presents itself—a whole nation cries " Manifest Destiny," and nearly every preacher in the land proclaims it to be the will of God. The gambler's faith in his luck—his constant belief that next time he will win, is but a fact similar to this.

It must be remembered, however, that though in every case the religion seems to give man this faith—it is the feeling of faith, this conviction of safety and certainty, which gave rise to this particular form of religious belief. On our thesis this feeling is one which has been selected in the course of evolution as a necessary factor in an environment of risk and uncertainty. It may have no objectification in religious or superstitious forms at all. In the case of men of genius this is often exemplified—as seen in the man who perceives a work to be done, precarious and uncertain in its outcome, yet who in his soul feels he is the man to accomplish that work and has little fear or doubt. This, says Pres. G. Stanley Hall, is the essence of genius. At root it is the same feeling or conviction of safety and certainty, as gave rise to such beliefs as luck, guardian spirits, and a special Providence. The only difference is that the man does not necessarily account for it by attributing its source to something external to himself, though often this is true as in case of Napoleon, "the child of destiny." From this standpoint we may expect a race in whom a large part of what we now call religious belief and motive, will be identical with normal life motives.

This factor of faith in self safety is often of a deleterious influence in cases of abnormal optimism where the individual trusts entirely to luck and not at all to his own effort. It is only too true that favorable chance is the goddess of the idle, the criminal and the desperate. On the other hand, this element of faith has additional value in that it places all the favorable things that happen to a man in italics. A horseshoe hung over your door is equivalent to underscoring everything fortunate which happens to you. The man who believes that he is lucky selects and isolates the happy things which happen to him. Further, the belief that you will succeed in an uncertain and difficult undertaking is often half the battle.

CONCLUSION.

In the preceding we have attempted to study the psychic attitude and reaction of man in the face of one of the great conditioning factors in life—that of chance and risk. Study shows two opposite feelings arising, fear and faith, *i. e.*, a fluctuating feeling of certitude. The one tends to make man withdraw or at least remain inactive; the other to throw aside the idea of a blind chance and to replace it by one of law or order, *i. e.*, a favoring will, and in consequence leads to taking risks and, in general, increased activity. In gambling this latter feeling expresses itself predominantly, as in this play the faith type of man is selected. His belief in his immunity from harm, in his final success, is his most marked characteristic. This feeling of certitude is the great biological organ which functions to suppress the idea of chance and to minimize the respect for the danger in risk. It is closely in touch with the philosophical question which is the paramount issue of every life—"How do I stand in relation to the deciding will?" It is not surprising that this factor should be central in that great species of adult play which we have attempted to analyze in this study.

(2) The preceding study also suggests that an environment of uncertain content may be necessary to the human species, inasmuch as it has been evolved therein; that it is an essential condition to give that state of suspense which is the ideal condition of all forms of pursuit. This need of tension, together with the feeling of faith in one's safety, is perhaps one of the most effective of all agents reacting against the great psychic tendency toward fixity, a tendency which expresses itself in the formation of habits, and in the accepting of absolute standards,—the natural end being arrest of development.

(3) A third point worthy of emphasis is the emotional intensity incident to gambling—arising from the presence of many of the strongest egoistic instinctive feelings. We find that this is one of the chief incentives to gamble. To seek intense states of consciousness seems, as many writers have pointed out, a normal tendency. This tendency, which seems on the increase, may be of high selective value. The influence of intense emotional states on the bodily metabolism is now well recognized. The Indians realized their therapeutic value when, in cases of sickness, large gambling parties were assembled in which all present became intensely excited, often nearly wild. To these conventions the sick were brought. This is very suggestive. The race has probably nearly reached its

limit in evolution along anatomical development. But physiologically, the possibilities are unbounded. May it not be that this increasing tendency to seek emotional states is an attempt, through natural selection, to put man on a higher metabolic level. The psychology of excess of all kinds becomes a large problem in this light.

It is significant to note that we find gambling very prevalent in the early formative periods of society, and in newly exploited countries. Under these circumstances, the will to live increases with the increase of danger and uncertainty. Hence, intense emotional states which increase the feeling of the reality of self as well as the bodily metabolism—are sought. This, together with the exercise of the feelings of hope and faith in self that gambling affords, makes it in early states of society attractive. So in later periods gambling is indulged in as an outlet, a channelization of the pent up biological forces which a narrow specialized life does not afford. Man's biological heredity in the manifold form of various egoistic impulses cannot be ignored. They demand expression. There is, so to speak, a katabolic imperative. This outlet gambling furnishes in that it so well simulates the environment of primitive man. Again, a man in a narrow specialty feels his restrictions. He may be making needles and feel that he can make a machine. But give him strong emotional excitation, which increases the entire bodily metabolism, and he is on the metabolic level that he would be on were he making machines. He has all the enthusiasm and feeling of genius for the moment, though he may not be doing the work. Such results, gambling excitations, alcoholic intoxications, and the like produce. The problem is how to give normal emotional channelization, the safety valve of this biological heredity.

(4) The study of the gambling impulse further emphasizes the fact that man easily gives up the intellectual for the instinctive life; that he has not learned, as well as many writers would have us believe, the lesson of work and the power of sustained voluntary attention. This has been considered one of the great achievements of civilization. One of the chief motives for gambling, as we have seen above, is to obtain the rewards of labor without laboring. This is one of its chief pleasures, to have acquired a dollar without sustained toil. It is also worthy of note that often the gambler expends as much energy in obtaining his dollar as if he labored for it. In the one case, however, the attention is spontaneous, in the other voluntary.

(5) In the light of this investigation a few words in regard to theories of play may be instructive. It is a fair question whether plays of adults must be put under a different category

from plays of children. Let us take a retrospect. We have been dealing with a form of play found among all peoples. The following points are most significant: (1) Gambling has for one of its chief motives the acquisition of property—in other words, power. (2) Gambling calls forth some of the deepest of human instincts. It is a courting of fear—fear with which you must trifle, if, as it has been so well expressed, you wish to taste the intensest joys of living. So, also, it is the seeking after feelings of faith in self-safety in the face of danger—a play upon the hereditary orchestration of success in the race; a feeling which is our legacy in being the progeny of the survivors and the fit in the struggle for existence. So also, as we have seen, gambling raises into consciousness many egoistic instinct-feelings,—as the desire to dominate and humiliate your fellow, the love of conflict—your courage and power against mine, the satisfaction of being the object of jealousy, the pleasures derived from the exercise of cunning, deceit and concealment. (3) Gambling also excites the deepest of all interests in life—that in the transcendent, the dark obscure beyond. This, together with the general uncertainty of the environment, together with the fluctuations betweeen faith and in self and ever recurring fear—plus the ever present seeking for material gain—gives that tension which to many is the very definition of life.

Can you find a half dozen deeper things in man than these, which form the very nucleus of this great play? It is, indeed, a simulation of life feelings. But of life in which all pity and sympathy for man is absent; in which self is the all important center; in which to gain, to fight and to feel God is with you, are all in all; in which each of these is intensified and exaggerated. Neither the theory of play set forth by Spencer nor that of Gross, nor any of the theories of play the writer has met, wholly satisfies these conditions. We meet here with an expression of instinct centers which no doubt are highly anabolic. But it is not necessarily a case of surplus energy in the organism which is the meaning of Spencer as I understand it. If these psychic phenomena be latent in some organic condition, and their manifestations depend on the cells of these organic centers being in an anabolic state, ay it not be that those centers which are oldest, acquired st in the process of evolution, are first objects of nutrition, d that each organic center receives energy according to its ority of age, especially if for a long period it was required function actively in the preservation of the species. Thus ight result, where the supply of energy was at any time ufficient for the whole organism, that these oldest organic ters would be nourished, while variations acquired later would not, even though these might be of more value at the time in fitting the organism for survival. One answers immediately that those old organic conditions, having ceased to be of value and having become rudimentary organs, are finally sloughed off. But is this the case in the psychic realm? Is it not true that organs only become rudimentary through disuse? Do psychic centers ever cease to function actively? Do not old instincts—though of no value at present—still receive exercise by thrusting themselves at every possible opportunity into activity—especially in moments of recreation—determining thus, as I have mentioned, the forms and nature of play? At least it is clear, that this being the case, they tend to become rudimentary much less than is the case with other organs of the body. Even with these latter, may it not be that organs, such, for example, as the tail of the monkey, long resisted degeneration because, even after the establishment of the monkey in the terrestrial environment, the tail was used to swing the monkey in moments of recreation. Certain it is, there is a glow of satisfaction in using these once valuable organs. So in the psychic realm even though these instinct centers may in time become rudimentary, is it not at least clear that they resist degeneration a long time by thus expressing themselves in forms of play in moments of recreation? In the light of these considerations play, especially adult play, becomes a subject of not a little sociological and ethical importance. Thus in play, for a long time at least, a race would revive its psychic past, having created the stimuli prevalent in the primitive environment. Play would thus be an index to the history of the psychic life—a kind of historico-anthropological theater.

(6) As to the contribution of this study to the subject of ethics, it seems to the writer there is much which speaks for itself. Conduct is the result of latent biological forces; much conduct, being the forced expression of highly anabolic instinctive centers which have functioned through long previous periods in preserving the species. These resist for a long time degeneration, do not tend readily to become rudimentary, and hence are ever on the threshold of activity. Prohibition is impossible. If this activity is a menace to our present social conditions, substitutions must be offered. In other words these instinct-activities must be channelized into harmless courses. To accomplish this there is necessary a thorough study of these instincts in their biological and genetic origins. This gives us a hint of what ethics and also sociology may gain by leaning on their natural supporter—psychology.

of prime importance and is entitled to at least super-Family rank; (8) the existence of this mechanism explains *why* with in-cooling spawning[1] is, and *must be*, associated to-cooler[1] migration and boreal distribution, and with in-warming spawning, to-warmer migration and austral distribution; (9) by a working backwards from the time of most successful hatching, the time of spawning has been determined via natural selection; and (10) the time of spawning being so fixed, by a further working backward, natural selection has determined the time of precedent migration.

SPAWNING HABITS.

1. *The significant fact in the temperature relations of fishes is the distribution of spawning with reference to the signs of the temperature zodiac.*

As to the temperature relations of spawning, it must first be noted that it is nearly all concentrated into two fairly distinct periods, a fall period from about September 1 to freezing (November), and a spring period from thawing (March) to about July 1. It is not contended that these limits are exact. Some fall spawning begins late in August, or even a little earlier in high latitudes and altitudes, and a somewhat larger amount lasts into December, but this is merely delayed fall spawning. The very purpose of this paper, however, is to insist upon the fact that the determinant is *not* the calendar, but a given temperature *taken in connection with the direction of temperature trend.* Mere contact with water of a given temperature cannot alone be the cause of spawning, for in the nature of things such contact occurs twice every year, once on warming water and once on cooling water, while spawning occurs but once. Though perhaps not entirely new, this relation needs to be emphasized and may be thus formulated: *As regards spawning, fresh water (and probably all other) fishes fall into two groups, those which spawn in warming water and those which spawn in cooling water.*

2. *The cause*[2] *of spawning is the definite temperature trend in* one *direction.*

With marine fishes our knowledge is least certain for those species which, like the cod, spawn eggs which rise to the surface ("floating" eggs). But everything we do know tends to show that with them, too, water temperature is the cause of spawning; for they spawn within fairly close time limits, and spawning is retarded or advanced by unusual fluctuations of temperature from the average, just as is the case with the beach spawners and the anadromes,[1] where our knowledge is more complete.

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[1] In-cooling spawning: Spawning in cooling water. To-cooler migrating: Migrating from warmer water to cooler.

[2] Or, better, the environmental factor, the immediate stimulus.

The rule certainly holds for the ocean bottom spawners. Thus, to take a single instance, the movements of the Norwegian herring (which spawns in warming water) to its spawning grounds depend on temperature, most being caught on the spawning beds between 12 and 14° C., cold weather diminishes the yield of the fisheries, the higher the temperature the deeper the spawning grounds, and the Dutch fishermen set their nets by the thermometer.

With both beach spawners and anadromes, in the case of those species ripening in warming water, spawning takes place in a regular progression from south to north. Occasional accordant exceptions occur. For an actual example, an in-warming-spawning species is known to spawn earlier in the northern of two closely approximated streams that stream being from local causes the warmer. Further, the regular progression across the parallels of latitude finds its counterpart in an equally regular progression with increasing altitude. Moreover, spawning takes place earlier in warm seasons, and later in cold ones. With shad the proportion of ripe females taken early in the season, to the whole number of ripe females caught, is greater in warm seasons, and then ripe females are scarcer later in the season. The exact reverse holds for those species which ripen in cooling water, an equally regular progression occurring from north to south and from high altitudes to low. In cold seasons spawning takes place earlier, in warm seasons later, and it occurs earlier in the colder of two otherwise similar and closely approximated streams. Finally, there is actually observed with both classes of fish, a thorough correspondence, increment for increment, between progressive approximation in water temperature to the spawning point, and progressive approximation in the reproductive organs to full ripeness.

3. *Structurally similar forms tend strongly to sustain similar relations to the temperature curve, that is, to spawn either all on its ascending or all on its descending limb.*

This subject cannot be here treated in extenso but it may be mentioned that all the minnows (Cyprinidæ), the catfishes (Siluridae), and the sunfishes (Centrarchidæ), spawn in warming water, while among fishes spawning in cooling water are all the cods (Gadidæ), and also probably all the Salmonids. The last will now receive more extended discussion. The following is a list of the native American species with their spawning times:

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[1] Anadromes: Fish ascending rivers annually to spawn.

THE HABITS OF FISHES.[1]

By Revere Randolph Gurley, M. D.
Sometime Fellow in Clark University.

Introduction.

In reading Darwin's *Expression of Emotions* one becomes impressed with the idea that while for the special purpose to which that work relates, it suffices to say that certain movements are the direct outcome of the constitution of the nervous system, for the broader purposes of evolutional neurology the real question is: How did the nervous system come to be such as it is; that is, how has it come about that there has been developed just that series of nerve mechanisms which corresponds to the demands made upon the organism by its environment? It is not enough to say that it has arisen through natural selection unless we can, without violating scientific probability, show in some precise and detailed way how the necessary gradations could have arisen and been selected. Instead of looking around for a god-send in the way of "spontaneous" variations we would, as Eimer insists, better look to physiological laws for the basis materials upon which natural selection can work. To this end the tracing of the steps by which, in the fishes, from a comparatively simple instinct, a comparatively complex instinct with various accessory instincts, has arisen, cannot be without value; for it shows how a progressive change of conditions in the environment has originated a definite correlative change of function in the organism. And the paucity of cases in which such a definite correlation is demonstrable, renders every one valuable.

In the study of animal psychology one method especially offers a chance which should not be neglected, namely the comparative method. Careful observation and comparison from species to species of a genus, from genus to genus of a family, and from area to area (geographical distribution), may be expected to give some clue to relative antiquity of instincts; the oldest instincts, like the oldest structures, being (in general and subject to more or less qualification) those in which the most species of a genus, genera of a family, etc., agree; and the most recent being those in which the species, genera, etc., differ the most.[1] The present method of studying the psychic development of the young is, of course, excellent. But just as comparative anatomy preceded embryology, so here, as a preliminary, the comparative may prove more profitable than the developmental psycho-physiology.

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[1] This paper embodies conclusions formed in part during five years of work in the U. S. Fish Commission, and in part as the result of a collection and comparison of all data upon the habits of fishes in the first two Reports of the Commission, made while at Clark University. I here extend thanks to Prof. B. Warren Evermann and Dr. Fritz Schwyzer for their kindness in criticising manuscript, and to Dr. W. C. Kendall for furnishing data.

For the evolutional physiologist the most important task is the locating of the cardinal points of the spiral life curve, that is, the division of the life cycle into its separate terms, the analysis of their interdependence, and the determination of their order of sequence *and the conditions which determine that order*. In the fishes the determination of these cardinal points is, fortunately, not difficult. They here mark the periodically recurring instincts of migration and reproduction. And just as we find Ryder[2] implying that repetition of structure is conditioned upon repetition in embryonic environment, so here we can assert that cyclical recurrence of instinct is the outcome of cyclical recurrence of environmental stimuli.

Considering that on account of their economic importance, we have a fuller and more accurate knowledge of the habits of fishes than of those of other animals, it is surprising that up to the present there has been no attempt at a connected and systematic presentation. Except for a few paragraphs in Darwin and a few pages in Romanes, there is practically no literature apart from numerous scatterd notes, mostly in the Reports of the various Fish Commissions and Fish Cultural Societies. The present paper is merely an attempt to bring order out of chaos.

The conclusions arrived at are: (1) the significant fact in the temperature relations of fishes is the distribution of spawning with reference to the signs of the temperature zodiac; (2) the cause of spawning is the definite temperature trend in *one* direction; (3) structurally similar forms tend strongly to sustain in their spawning similar relations to the temperature curve; (4) in at least some cases apparent exceptions can be harmonized with the law; (5) for a given species the temperature relations which determine its migration and probably also its geographical distribution, are the same as those which determine its spawning; (6) these facts demonstrate the presence of a temperature responsive nerve mechanism; (7) this mechanism is a character of prime importance and is entitled to at least super-Family rank; (8) the existence of this mechanism explains *why* with in-cooling spawning[1] is, and *must be*, associated to-cooler[1] migration and boreal distribution, and with in-warming spawning, to-warmer migration and austral distribution; (9) by a working backwards from the time of most successful hatching, the time of spawning has been determined via natural selection; and (10) the time of spawning being so fixed, by a further working backward, natural selection has determined the time of precedent migration.

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[1] No one will suppose that this is regarded as a new method. In Comparative Psychology, however, it has not been utilized to any extent.

[2] Woods Holl Lectures for 1894, 1895, pp. 23-55.

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With both beach spawners and anadromes, in the case of those species ripening in warming water, spawning takes place in a regular progression from south to north. Occasional accordant exceptions occur. For an actual example, an in-warming-spawning species is known to spawn earlier in the northern of two closely approximated streams that stream being from local causes the warmer. Further, the regular progression across the parallels of latitude finds its counterpart in an equally regular progression with increasing altitude. Moreover, spawning takes place earlier in warm seasons, and later in cold ones. With shad the proportion of ripe females taken early in the season, to the whole number of ripe females caught, is greater in warm seasons, and then ripe females are scarcer later in the season. The exact reverse holds for those species which ripen in cooling water, an equally regular progression occurring from north to south and from high altitudes to low. In cold seasons spawning takes place earlier, in warm seasons later, and it occurs earlier in the colder of two otherwise similar and closely approximated streams. Finally, there is actually observed with both classes of fish, a thorough correspondence, increment for increment, between progressive approximation in water temperature to the spawning point, and progressive approximation in the reproductive organs to full ripeness.

3. *Structurally similar forms tend strongly to sustain similar relations to the temperature curve, that is, to spawn either all on its ascending or all on its descending limb.*

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[1] Anadromes: Fish ascending rivers annually to spawn.

		In cooling water.	In warming water.
Whitefishes (*Coregonus*); 8 species,	Late fall	x	
Atlantic Salmon (*Salmo salar*),	" "	x	
Sebago Lake Trout (*Salmo salar sebago*),	" "	x	
Columbia River Trout (*Salmo mykiss Clarkii*),	Spring		?
Yellowstone or Cut-Throat Trout (*Salmo mykiss Lewisi*),	"		?
Utah Lake Trout (*Salmo mykiss virginalis*),	"		?
Steelhead (*Salmo Gairdneri*),	Feb.-May		?
Rainbow Trout (*Salmo irideus*),	Nov.-May[1]	x	
Brook or Speckled Trout (*Salvelinus fontinalis*),	Late fall	x	
Greenland Charr (*Salvelinus alpinus stagnalis*),	" "	x	
Dolly Varden Trout (*Salvelinus Parkii*),	" "	x	
Chinook (or Quinnat) Salmon (*Oncorhynchus tschawytscha*),	July-Dec,[2]	x	
Blueback Salmon (*Oncorhynchus nerka*),	Aug.-Nov.	x	
Humpback Salmon (*Oncorhynchus gorbuscha*),	Aug.	x	
Dog Salmon (*Oncorhynchus keta*),	Sept. or somewhat earlier	x	
Silver Salmon (*Oncorhynchus kisutch*),	Late fall, early winter	x	
Great Lake Trout (*Cristivomer namaycush*),	Sept.-Dec.	x	
Grayling (*Thymallus signifer*),	April		?

From this list it appears that as a whole the Salmonids are fall spawners, that is unquestionably spawners in cooling water; but a few species are aberrant in this respect and this brings us to our next consideration.

4. *In at least some cases apparent exceptions can be harmonized with the law.*

Before taking up this proposition, however, one current but erroneous idea must be corrected. In so far as it has been alluded to at all, it seems to have been tacitly assumed that spring spawning *must* mean spawning in warm water. So unquestioningly has this been assumed that there are few thermometric data to which to appeal. It is, however, demonstrable that at least it may be, and it is quite probable that in some cases it is, associated (via a temperature induced migration) with the exact opposite, viz., spawning in cooling water. As examples of the latter may be cited passage from the bottom water of a lake at maximum density temperature (4° C.) into tributaries just thawing (that is, approximating to 0° C.), and passage a little later in the season from a warming lake or ocean into snow fed streams. The assumption that spring spawning *necessarily* means spawning in warming water, is then entirely unwarranted.

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[1] See below.

[2] July only in high altitudes.

Now for the explanation of the aberrancies. The American Salmonids which exhibit the anomaly of spring spawning are:

Salmo mykiss (3 varieties).
Salmo Gairdneri.
Salmo irideus.

First, as regards the interrelation of the species. Jordan and Evermann think *Salmo Gairdneri* nothing but *S. irideus* which has descended to sea and returned, and Gilbert and Evermann know no way of distinguishing the young of the two species. Whence it is at least possible that the three exceptions are in reality but two.[1] Second, in all these forms the spring spawning either ensues upon migration into, or takes place in mountain (and mostly, if not entirely, ice-fed) streams which, as has been shown, do not necessarily warm with the advancing season, the ice or snow only melting the faster. Third, in the case of *S. irideus* we are not confined to presumptions. In the McCloud River, California, it spawns from January 1 to May, but that this is *not* spawning on warming water is shown conclusively by the fact that when brought from the McCloud to the Wytheville, Virginia, hatchery, it shifted its spawning time *not forward to spring but backward to fall*, and spawned from November to March. The inferences are that at Wytheville a temperature is reached in November which is not reached in the McCloud until January, and that the McCloud is about the southernmost point in the distribution of the species, because farther south the temperature in winter does not sink to the spawning point. The large salmon of the Danube (*Hucho hucho*) runs up the tributaries of that river from March to May to spawn. In the absence of data and considering the similar migration, it is not unreasonable to suppose that this species, and also the graylings which spawn under similar conditions of migration, may conform to the rule.

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[1] The case stood thus when the above was written in 1895. In the latest authoritative pronouncement (Jordan & Evermann, 1896, Bull. U. S. Nat. Mus., XLVII, pp. 488-500) all three species are recognized, but apparently as foci around which a number of variations group themselves, and intermediate varieties are referred to.

5. *For a given species the temperature relations which determine its migration, and perhaps also its geographical distribution, are the same as those which determine its spawning.*

Under Migration Habits it will be shown that those species which are stimulated to spawn by warming water are equally stimulated to migrate by warming water, and *vice versa* for forms stimulated to spawn by cooling water, subject only for the Salmonids, to the (probably only apparent) exceptions already discussed. It remains here only to point out that those forms which spawn in warming water are all austral forms, whereas those which spawn in cooling water are all boreal forms. Both of these classes meet in the temperate zone, but it seems a fair inference that their range, northward in the one case and southward in the other, is checked at the limits where their respective spawning temperatures disappear; that is, the austral forms cannot range farther north than the place at which the highest summer water temperature reaches the spawning point, or the boreal forms farther south than the place where, at the lowest winter temperature, the water cools to their spawning point. At least the high altitudes which mark the southernmost limits of the ranges of the rainbow and the Yellowstone trouts, speak for this view.

6. *These facts demonstrate the presence of a temperature-responsive nerve mechanism.*

The word "demonstrate" is used advisedly, for it would be literally inconceivable (that is, opposed to all biological analogy whatever) that such a progressive development of the reproductive organs, extending over months, should be independent of nervous control. Any objection based on the lack of actual anatomical demonstration of the mechanism, would prove equally well that the mammary development of pregnacy is independent of nervous control. Consisting of more than one neurone (a nerve cell plus its fiber), the utero-mammary reflex arc cannot be demonstrated anatomically, that is, by the usual degeneration methods. Still its existence *must* be conceded throughout the whole mammalian class; and as it is not known outside that class, it becomes just as important a taxonomic feature as the uterus or mammæ, for, like them, it persists over equally wide groups, areas and times. As biological philosophers, therefore, it behooves us to remember that besides the convenient, naked eye anatomical characters utilized for classification, a number of physiological characters exist which are perhaps less immediately evident, but which are none the less real and important.

7. *This mechanism is a character of prime importance and is entitled to at least super-Family rank,*

For it plays the dominant roll in the fish's life. Just as much as, if not indeed more than, the Salmonidæ are fishes with abdominal ventral fins, two dorsal fins (an anterior rayed, a posterior adipose), scaly bodies without barbels or spines, with distinct maxillaries, naked head, ctenoid scales and siphonal stomach with many pyloric cæca, are they fishes which (on the whole and small fluctuations in the life cycle perhaps apart,) *tend to seek cooler water*. Indeed, this is their fundamental dynamic character, the character which is back of their migrations and habitats, which latter have, in turn, developed their generic and specific differences. In every element by which we rate the taxonomic value of biologic characters, namely persistence over wide groups, areas and times, this nerve mechanism (demonstrated by its effects) must be accorded high biologic rank. For though the Salmonids have been able to change almost everything else (habitat, mode of life, feeding habits, etc.) and coincidently have varied through species and genera into families, there is not at present a proved instance of any species having varied to spawning in warming water. Indeed there would seem good reason for believing that they could not possibly so vary, for a change by an abrupt shift-over would manifestly be impossible, and slow variations toward such a change could only consist in a shifting of the spawning time toward a warming water season, a shifting which, as shown on p. 416, would necessarily be eliminated through natural selection.

It must be accorded at least super-Family rank inasmuch as both the Argentinidæ (capelin and smelt family), and the Salmonidæ (salmon family proper) in all its genera and species as far as at present known, agree in possessing it. That is, it antedates their divergence and, if the considerations urged on p. 420 have any force, it certainly antedates the present streams, since when the anadromous Salmonids were beach spawners it already dominated their to-beach migrations.

8. *The existence of this mechanism explains* why *with in-cooling spawning is*, and must be, *associated to-cooler migration and boreal distribution*, and with in-warming spawning, to-warmer migration and austral distribution.

No species could be at once in-cooling spawning and to-warmer migrating, because it would constantly migrate away from the only waters capable of developing the reproductive organs. Further, were such a combination possible, we should find at least some in-cooling spawning species with an austral distribution, but we do not. When, however, we once admit the necessity of the co-existence of in-cooling spawning with to-cooler migration, as two phases of action of the same nerve mechanism, we at once see *why* in-cooling spawning and to-cooler migrating species must have boreal distribution. For they will constantly be fended off from the warmer southern waters both by repulsion of contact and by the inability of finding there water cool enough to develop the reproductive organs. *Mutatis mutandis*, we have a similar explanation for the actual association of in-warming spawning with to-warmer migration and austral distribution.

If it is urged that *a priori* we might conceive of cyclical variations (between, merely by way of example, a summer to-warming and a winter to-cooling impulse or, *vice versa*) it can only be said that though the possibility is not to be denied, no such actual case is known.

9. *By a working backward from the time of most successful hatching, the time of spawning has been determined via natural selection.*

Though the conditions are such that general reasoning can hardly be gainsaid, probably the best proof of this principle is the following actual case. In the early days of fish culture Mr. N. W. Clark hatched whitefish eggs in spring water at 47° F. with the result that hatching took place too early, all attempts at artificial feeding failed, and the fry starved to death. Next year he used the same spring water, merely interposing a cooling ice pond, and 50% were successfully hatched, beginning about April 1.

The whole subject being epitomized in this case excessive elaboration of argument is unnecessary. The fry must not hatch too early or they will starve, their food not hatching out until about March or April. If they must not hatch too early the eggs must not be deposited too early, and those fish which spawn too early will leave no descendants to perpetuate their over-readiness.

Equally they must not be deposited too late. Here, however, the environmental conditions are not so exacting, and accordingly we find that with most of the late fall spawners the end of the spawning season is not so sharply defined and tends to fray out into the winter. At the beginning of the season the water is comparatively warm and each day involves a disproportionate amount of development, but as temperature lowers each day possesses a constantly decreasing incubation value.[1] A few days too late, therefore, has no such potent effect as a few days too early. Besides, a delay of a week at 33-35° F. in spawning will be made up rather quickly as the water warms in spring, every day then doing as much as several in winter.

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[1] The rule of 50 days at 50° F. and 5 days more or less for every degree lower or higher, holds fairly well for many of the Salmonids. Attention is directed to the very great variation in time for a small variation in temperature. Thus compare 50 with 45 and 35. At 50 each day represents 1/50 of the development, while at 45 it represents only 1/75, and at 35 only 1/125 of the whole development.

That this reasoning is correct may be inferred from the comparatively few cases of fall spawners whose eggs hatch before winter. With the Chinook Salmon, for example, the limit of the end of the season is almost as sharp as the beginning. Unlike the later spawners which, stimulated to spawn when a certain point is reached, continue to be stimulated for a number of degrees below (that is, the stimulus does not press simultaneously and with irresistible force on all individuals alike), the vast majority of the Chinook Salmon spawn within a short time (about two weeks, at any one place). And why? Because their eggs hatch in about 35 days and the fry must be out and sufficiently developed in time to seek winter quarters.

It is not to be supposed, however, that delay in deposition beyond somewhat narrow limits, is an indifferent matter. Eggs that do not hatch about the time of thawing produce fry belated in the race and which stand a greatly increased chance of destruction, for at this period a week's delay is serious. Every day hosts of hungry enemies ready to seize them in the egg, are arousing from their winter's sleep, and even after hatching the critical period of egg sac absorption, when the fry are feeble and hampered in their movements by the bulky sac, must be passed through in the face of the enemy. So that it is certain there is some limit and that here, too, natural selection has set its seal.

With the spring spawners natural selection has also operated but in a different way. The most characteristic difference between the spring spawners as a class and the fall spawners as a class, is the rapidity of incubation in the former. In part this is, of course, attributable to the higher water temperature, but the disparity is sufficient to indicate that natural selection has come into play. For example, shad eggs require only from 10 down to 4 or even 3 days for incubation, according to the temperature.

In the late fall and through the winter the sandy-gravelly beaches and shallows are deserted, for at the advent of ice they are abandoned by the spawn eating fishes which take refuge in the warmer depths. It is at this period that most beach spawning occurs. Here the eggs lie in comparative safety through the four months required for their development in the icy waters. But in spring on the open beach, eggs are very much exposed to enemies, to fungus and to asphyxiation by mud. Consequently, other things being equal, those eggs will succeed best which are held back (that is, the spawners of which are not stimulated to spawn) until the temperature has risen to such a point as to minimize the time of exposure on the beach. These considerations are reinforced by the known facts that the fry have somewhat narrow temperature limits of maximum vigor. Thus, lethargic below 65°, shad fry thrive between 68° and 72°. En route to Germany they weakened very fast at 73° and all died in four days.[1] On transcontinental journeys 62-75° was tolerated, and 80° was the danger point. Thus, there must be some upper temperature limit beyond which extinction lies. Whence, among a number of eggs deposited over a somewhat protracted period, those will hatch best and the fry from them will thrive best which were spawned at the right time for the average season. The only way by which such an arrangement could be affected is by the selection of individuals varying favorably with respect to a thermal reflex arc.

10. *The spawning time being so fixed, by a further working backward the time of precedent migration has likewise been determined by natural selection.*

For if they are to spawn at a certain place at a certain time they must leave in time to reach it. We may naturally expect that they must start within fairly narrow time limits, for while laggards will leave no progeny to perpetuate their unreadiness, on the other hand they cannot start too early because, for many species at least, their stay in fresh water leads to death from exhaustion, the outcome of abstinence from food, injuries and attacks of fungus (*Saprolegnia*), immediately after spawning. Their stay in fresh water, therefore, while it must be long enough for spawning, cannot be much lengthened with impunity, or death would precede spawning, thereby bringing about the elimination of the over-ready.

MIGRATION HABITS.

Although we are not here directly concerned with the origin of the seek-the-beach impulse, that impulse being taken as our point of departure, it may be pointed out, parenthetically, that it is as certainly temperature-induced as its derivative, the anadromous habit; for the evidence is of the same kind and amount in the one case as in the other, the to-beach migrations taking place in a regular succession from parallel to parallel, northward in the case of species migrating on warming water, and southward in the opposite case. Indeed, so regular is this succession that along-shore migration was formerly believed in.

now come to the consideration of the anadromous, or river
ing habit. Facts will be adduced to prove that this habit
an extension and further elaboration of the seek-the-
ulse. The foregoing contentions being admitted, the
ts of a sound hypothesis will be satisfied if it can be
: A, there are *de facto* beach spawners; B, in type
beach spawners agree with the fresh water species,

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here other factors (lack of change of water) co-operated.

and differ from the pelagic forms, and that this difference suffices to explain (a) why species of pelagic genera are so rare in fresh water, and (b) why beach spawners are now so uncommon; C, having once attained to a seek-the-beach impulse, the conditions on the beach were such that, natural selection not opposing, the beach spawners must, through the mere continued action of the temperature responsive mechanism, be led, step by step, into the forming streams of a rising continent; and D, in the streams the necessary accessory habits have been evolved, all in accordance with accepted biological principles.

A. *There are de facto beach spawners.*

On the English coast at least eight species are known which it is unnecessary to enumerate.[1] More important, as being nearly related to the Salmonidæ, is the surf-spawning capelin (*Mallotus villosus*). The herring (*Clupea harengus*) is another species spawning above the ooze area.

B. *In character of egg the beach spawners agree with the fresh water species, and differ from the pelagic forms, and this difference suffices to explain: (a) why species of pelagic genera are so rare in fresh water, and (b) why beach spawners are now so uncommon.*

The eggs of the true fishes (Teleosts) are mainly of two classes, sinking eggs and floating eggs. In either class the eggs may be separable or adhesive.[2] The sinking egg and the adhesive floating egg occur on the beach and in the streams. The free floating egg, however, never occurs in fresh water. Indeed, it could not possibly occur there, as experience in the artificial hatching of these eggs has abundantly demonstrated that the slightest sediment is fatal to them (causing them to sink and those that sink are inevitably lost), and further, that motion is equally fatal, rupturing their delicate shells. Here, therefore, we find a sufficient reason why all marine forms have not become anadromes. Besides it was not necessary that they should, for natural selection has operated to preserve them in an entirely different way, namely by a vast increase in fertility and by throwing over their eggs the Perseus cap of transparency.

If these considerations are correct, it is easy to see why beach spawners are now comparatively uncommon. For on account of their egg type they have always been potential anadromes, and, for reasons given below, the mere continued action of the seek-the-beach impulse must have tended to impel them into the forming streams. That the egg type is the determinant factor in the matter is further implied by the fact that the only fresh water species of the pelagic cod family, namely *Lota lota*, has simultaneously with its deviation from the ancestral habitat, deviated from the ancestral to a fresh water type of egg (sinking egg of large size as against the minute floating eggs of its pelagic congeners).

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[1] McIntosh: Bull. U. S. Fish Com. for 1893 (1894), XIII, pp. 241-44.

[2] For purposes of fish culture adhesiveness is so important a quality that eggs possessing it are grouped into a separate class.

C. *Having once attained to a seek-the-beach impulse the conditions on the beach were such that, natural selection not opposing, the beach spawners must, through the mere continued action of the temperature responsive mechanism, be led, step by step, into the forming streams of a rising continent.*

For if, as urged, that impulse is induced by temperature stimulation of a reflex arc, then on a rising continent with its gradually forming streams, there must occur just that further elaboration of the seek-the-beach impulse that we now see in the anadromous instinct, provided only that natural selection does not oppose. For with a progressively chilling atmosphere, the coolest water will be found where the proportion of water surface and water movement to water bulk is greatest, as in shallow bays, and *de facto* the capelin spawns in the surf. But the coolest of all will be found in estuaries, for here it comes from the streams where the proportion of surface and movement to bulk is ad maximum. Wherefore, to-cooler migrating species advancing to the beach will be deflected more into the estuaries and most into the streams. Up these they will, in accordance with the ever acting physiological impulse of seek-the-cooler, gradually progress, for with the lengthening of the streams the coolest water will ever be found at the receding headwaters.

And, parenthetically, what has been shown here for to-cooler migrating and in-cooling spawning forms, applies equally well, *mutatis mutandis*, to to-warmer migrating and in-warming spawning species. They will find warmer water in the estuaries, and the warmest of all in the streams.

The determinant of the salmons into the rivers would thus appear to be difference of temperature. What actual evidence is there for this view? Jordan[1] says the blue-back and humpback salmons ascend only snow fed streams having sufficient volume to send their waters well out to sea. Contact with cold
probably brings them up earlier than would otherwise
Spring freshets mean heavy spring runs and
lighter fall runs. Evermann thinks fresh water,
ater of a colder temperature, is the determin-
r). And Armistead says that though it has
"fish"[2] pass from the sea into the rivers be-

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es, 1888, pp. 51-52.
Com. for 1893 (1894), XIII, pp. 93-99. "Fish" is
nent, as everything turns on the species. But it will
nentions "salmon."

cause the latter are warmer, he has found the sea, at least in some places, in late spring often a great deal (very often 10° or more) warmer than the rivers. When in early spring sea temperature is low, no such large runs occur in the Solway as later. In March with east winds, salmon do not run nearly so well as in April, or in April as in May. At Douglas Hall, though fishing was legal from February, the spring run was so regular that nets were not set (scarcity making it unremunerative) before the end of March and some not before April. But later, as the sea warms, a good many run. If it remains cold and the sea temperature low, none run, but as soon as the condition reverses, in come the fish.

Now while, as has been shown, in general river temperatures fluctuate more rapidly than sea temperatures, this does not necessarily apply to streams which flood in spring from the melting of ice and snow. On the contrary many and (though length and volume would make each case different) probably most of such streams retain a low temperature for weeks, in fact till the complete melting of the ice supply. These facts are, moreover, perfectly consonant with the fact that in general the runs of the Salmonids of our west coast take place in the spring progressively from south to north, for the sea warms and the ice melts progressively from south to north, both factors cooperating to make the rivers relatively colder. Further, it agrees with the fact that the runs occur earlier in warm seasons and on freshets. This view accords well with the fact that the blue back and chinook salmons run in both spring and fall, for twice the rivers must be a given number of degrees colder than the sea, while it also affords an explanation of the fact that the dog, humpback and silver salmons do not run till fall, for these last three species are probably out of reach of the rivers. Thus when they come in from sea (which the dog salmon is definitely known to do) they are probably too late to strike cold river currents, the rivers having by that time approximated to or overstepped the sea temperature.

D. *In the streams the necessary accessory instincts have been evolved, all in accordance with accepted biological principles.*

The older fish culturists and some ichthyologists held the view, often in a rather extreme form, that the anadromes were guided by an unerring instinct back to the place of their origin, and such statements were current as that a fish might be depended upon to return not only to the same river in which it was hatched, but to the same tributary of that river, and again, that a fish hatched below a dam would have no instinct to go higher than that dam, wherefore if it were desired that the young on their return from sea should go higher, the eggs must be hatched higher up, etc. Jordan[1] has, fortunately, exploded this myth, and given a rational and credible explanation which does not deify instinct and make of it a fetich. Briefly, he says fish do not always go up the same river and when they do it is because not ranging far off shore, the chances are large that it will be the current of *that* river they will encounter first when moving inshore. As a defunct hypothesis, therefore, the older view will require no further notice.

The principal accessory instincts which have become superadded in the anadromes as a result of stream life are: *a*, abstinence from food; *b*, head-to-current impulse; and *c*, choice of spawning grounds.

a. *Abstinence from food*.

This habit has many degrees and probably is strict in direct ratio to the length of time required ad minimum and the amount of time available ad maximum, for the species to reach the spawning grounds. We may imagine that when the streams were short the fish could feed by the way and still reach the spawning grounds in time. Even this view, however, might have to be qualified, as only a short stay in fresh water is detrimental to some species from their susceptibility to disease, principally attacks of fungus. Still, in general the food-refusing habit is strict in proportion to length of travel, though this has exceptions, and it may be that in some cases absorption of impulse in the reproductive and motor systems, may suffice to explain the phenomena. It is, however, clear that there must be *some* length of migration which will require the fish to push on under penalty of being belated and leaving no progeny to transmit their hungriness and tardiness at the finish. Given, then, the ever lengthening streams of a rising continent, each year the journey is longer, and less time can be given to feeding by the way. Natural selection would then gradually weed out those individuals which had the feeding impulse strong, and favor those which tended to concentrate their feeding and motor-sexual functions into different portions of the yearly cycle. This is exactly what occurs with those salmons which return to sea after spawning, for they begin feeding voraciously on reaching salt water.

b. *The head-to-current impulse*.

Not the least brilliant page of Romanes's *Mental Evolution in Animals* is that in which he argues that the migratory instinct of the young bird is inherited memory, and that when it is asked: Memory of what, it suffices to answer: Memory of exactly what the old bird remembers, whatever that may be. He ends by citing the belief of Mr. Black that swallows migrate against the south wind, and points out that such a habit could easily be inherited, the warm moist wind exciting an impulse to fly against it. Whatever the case may be with swallows, a strictly analogous factor appears to be the dominant one in guiding the anadromes, namely the head-to-current impulse. This was discovered as soon as fish culture came into vogue. Some of the first fish culturists being somewhat sympathetic toward their finny friends which had such long distances to travel, conceived the idea of making pools in which the fish could rest in their progress up a fishway, with the result that the fish having, so to speak, lost their guiding star, after trying in vain to find among the cross currents a predominant one, finally gave it up and headed to the vortex current floated round and round with (or rather, against) it. Also fish neglect a fishway which does not have a sufficient volume of outflow to attract their attention to its mouth, and one which, though possessing a fair volume, is disadvantageously situated (for example, near a larger outflow, or too far downstream on one side) to follow the main current to the foot of the dam. Finally this head-to-current impulse is so strong that after the migration is over and the heading to current consequently is no longer of use, the salmons still head to the current when floating down stream. It is possible that in the case of species which return to sea, this may have a protective function.[1]

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[1] Science Sketches, pp. 58-59.

Having seen what determined the beginning of the journey we may now see what determines its end. Given the salmon type of egg and the anadromous habit, natural selection must eliminate all those individuals which do not continue to follow up the ever receding suitable physical conditions (gravelly stretches), and suitable thermal conditions. These coincide only at the headwaters. It is then not necessary to imagine an "unerring instinct." All we have to imagine is a fish started on its way in obedience to one stimulus (temperature trend) recurring in its environment in the exact order in which it has, during incalculable time, recurred in the environment of its progenitors, and, later, being forwarded on its way by a second stimulus (current) which succeeds the first in the exact order in which for incalculable time it has succeeded it in the history of the race; and further to imagine the fish impelled forward by pure *vis inertiae* until checked by the interposition of a supersessory inhibitory stimulus (approaching or complete ripeness) and its simultaneous arrival at the spawning grounds. For those who have followed the preceding reasoning, not much argument will be required to show that these last two factors must (through natural selection) coincide. To those who might, for any reason of their own, still urge that this view of a fish as on a par with an automobile torpedo, is inconceivable, it may be answered that while the fish may in addition be a more or less conscious torpedo, it is not necessary to assert it to be any more than such an automobile. In saying that it is a *fish* which is migrating we say it is an organism which has, via natural selection, become *oriented parallel to its environment*. Probably few realize fully what that means. It means nothing less than that to a certain stimulus (temperature trend) it *can respond but in one way*. There is no "choice" in the matter. If there were any "choice" in past ages, and the choosers chose otherwise, they went fossil rapidly and our fish is not their descendant. Again, saying it is a *fish* means that after responding to temperature trend in the one way possible to it, it will respond to the supersessory stimulus (current) in the one way possible to it, and so on. Thus a repetend of function arises merely through a repetend of stimuli, each singly evoking appropriate response in an animal which is *the* one out of many failures and partial successes which could respond *seriatim* in just the order and to just the extent demanded as the price of its existence.[1]

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[1] Very recently my friend, Dr. F. Schwyzer, has drawn my attention to the following: *Electrotropismus* by Eugen Blaisius & Fritz Schwyzer (Pflüger's Archiv., 1893, vol. 53). Among other facts the authors observed that under the action of the constant current certain Cyprinids (carp, tench, and others), and the brown trout (*Salmo fario*) underwent a remarkable and fairly constant re-orientation with the head to the positive pole. Fish might be supposed to be subjected to electric stimuli arising from friction between the water and its banks. On the whole, however, the facts adduced would seem to be of a different kind from those of electrotropism.

c. Choice of spawning grounds.

Spawning grounds are mainly of three kinds: mud, weeds, and sand, gravel and rock. The selection is by no means a matter of chance, and though too few data exist for the tracing of every detail, certain salient facts are explicable and at least some of the factors can be indicated. These go to show that the choice of spawning grounds has been determined by the egg type via natural selection.

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[1] After returning the proof I have seen the paper by Rutter in the *Popular Science Monthly* for July, 1902. It demonstrates beyond the possibility of cavil, the utterly mechanical and unintelligent nature of the phenomenon. In the ocean, fish in general, move against the various local currents produced by the tides. Thus a basis for the elaboration of the head-to-current impulse already existed, prior to the evolution of anadromy. Rutter shows that the Chinook (or Sacramento) Salmon runs into the rivers against the ebb tide. As soon as the tide turns the fish turn and run out against the flood tide. But the flood tide being of shorter duration than the ebb tide, they do not run out as far as they ran in. Consequently, day by day they ascend farther, until past the limital region where tidal movement gives place to river current.

Mud (apart from weeds). It is almost impossible that a mud bottom should be a successful spawning ground, as the eggs will almost inevitably be asphyxiated. Wherefore fishes experiencing an impulse to spawn on such bottom will leave few descendants to inherit their delicately sensitive mucous membrane, while those having an impulse to seek harder bottom will transmit to a larger progeny their more roborant mucous membrane. Further, the exception sustains the rule, the only species spawning on mud bottom being certain catfishes, the females of which excavate nests, and attend to (probably aerate) the eggs, and care for the fry.

Weeds. Here many species spawn, but they are those with adhesive eggs. In this case, too, physical conditions have determined function, for in these species the impulse to rub the genitals against the bottom is absent, the spawning being done at a leap at, or above, the surface.

Sand, gravel, and rock. The nature of these bottoms implies current or wave action sufficiently strong to habitually drive off the mud. And species with separable sinking eggs can safely deposit them here, and here only. Wherefore, given lengthening streams, those individuals will be constantly selected, which spurn the more accessible, softer bottoms, to ascend toilsomely to the current-swept stretches above.

On this class of bottoms some species build "nests" which can be traced in growing complexity. Probably mere restlessness while on the beds (which is exhibited by many species) may have formed the point of departure. This would be highly advantageous if it succeeded in covering over even only a few eggs at first, for the cover of porous sand or gravel would tend to preserve the eggs from egg eaters, and light,[1] and thereby to the predominant survival of over restless fish. The gradations in complexity of the nests favor this view.

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[1] In the early days 30,000 eggs were lost from diffused daylight, and now hatching troughs are provided with light-proof covers.

MENTAL GROWTH AND DECAY.[1]

By Edmund Clark Sanford.

Under cover of this somewhat vague title, I want to give you a psychologist's sketch of the course of mental development from the first beginnings of mind at, or before, birth to the final failure and break-up of the powers in old age.

The course of life from birth to death is a continuous one, but it bears at times such marked characteristics that it has been divided off by common consent into various stages, or ages of man, each more or less different from the others. Sometimes three or four stages only are made, sometimes a dozen or more. For our present purposes the traditional seven will be as satisfactory as any, and we shall subdivide where we find it necessary. We shall have, then, Babyhood, Childhood, Youth, Young Manhood, Adult Manhood (or Middle Age), the period of the Elderly, and that of the Aged. The most famous description of these is undoubtedly that of Shakspere in "As You Like It," but you will recall that it is there put into the mouth of the "melancholy Jaques" and it is in rather spiteful fashion that he describes them. In years the periods are about as follows: Babyhood, birth to 2 or 3 years; Childhood, 2 or 3 to 12 or 14; Youth, 12 or 14 to 25; Young Manhood, 25 to 40; Middle Age, 40 to 55 or 60; Elderly, 55 or 60 to 70; Aged, or Senescent, 70 and beyond. And once more let me say that the stages shift from one to another by imperceptible gradations, and that these limits, therefore, are not to be taken as rigid. They do not lie in the same years for all men; they shift and change from one to another. Let no one be offended, then, if my limits have put him in a stage where he does not feel that he belongs. In his case the limits are probably different.

Before taking up these stages individually let us look for a moment or two at the general laws of growth that apply to the course of life as a whole. One of these was formulated by Minot[2]—in the first instance for the general relations of physical growth. His statement is that "the time required to accomplish a change of a given extent increases with the age of the organism." It is as though the new-born organism were swept into being by a flood of vital energy which from that day sinks slowly to a mere trickle and then ceases altogether. If we come "trailing clouds of glory," it is this superabundant life that gives them their effulgence. The same law is true also of mental growth; and, allowing for certain important though temporary checks or even reversals in the tendency of the rate of change to fall off, it gives a true picture of the increasing fixity that is characteristic of advancing life. It is because the mental changes follow this principle and are most rapid and extensive in babyhood, childhood and youth, that we shall have to devote the major portion of our time to these periods.

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[1] Delivered as an address before the Philosophical Club of Bryn Mawr College, April 4, 1902. The manuscript is here reprinted practically as it was read, except for the addition of certain paragraphs cut out to shorten the delivery.

[2] Article "Age," Handb. Med. Sci., I, 87.

Closely connected with this, almost a corollary of it, is Fiske's observation that a lengthened period of infancy goes with a high grade of ultimate development. If the growth power is great and the growing period is long, opportunity is given for reaching high levels of development.

The second general law of growth is one formulated by Wundt.[1] He says, "the later stage arises solely from the preceding stage and yet appears to be a new creation in comparison to it." It is a law of "creative synthesis." "Each stage of development is already held in germ in the preceding," and arises from it "without the interference of any extraneous force, simply by the elevation [to higher potency] of the elemental psychical conditions already active there," "an advance immanent in the properties themselves," "never the entrance of a new specific 'psychic faculty.'" This means, as I take it, that at every stage we shall find sensations associated into perceptions and perceptions into apperceptive groups; that we shall find these colored, each in its degree, with pleasant or unpleasant feeling; that we shall find impulsive and voluntary movements, habits, memories, variations of attention, and all the other elementary psychical phenomena ever undergoing combination and recombination in an ascending series of complexity, till we reach the full range of adult mental life. We shall have abundant illustration of this in what follows, and in the way and to the extent that Wundt had in mind, the law is undoubtedly true, though it is not a complete statement of the matter.

But let us now return to our stages of life, and first of all to the period of Babyhood—the stretch from birth to the end of the second or third year—the time of close dependence upon the mother. The beginning of the period is definitely marked;

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[1] Völkerpsychologie, I, 242.

its close less definitely, though it may be set at the end of the teething period, two years to two years and a half, when the child is as ready as he will be for some time to deal with the common food of adults. Short as this period is, it is yet long enough to contain several quite distinct sub-periods. There is first the period of the *new-born*—the first few days after birth, when babies usually lose (or at least do not gain) in weight and are recovering from the catastrophe of birth and adjusting themselves to their new conditions of life. Here, for example, is the average change in the case of thirty-three children for the first six days: —139 grams, —64 gr., + 33, + 50, + 50, + 36.

Then follows the period of the nursing child up to the eighth or ninth month, or even to the end of the first year, during which he is getting control of his sense organs and his muscles, and making his first beginnings of the knowledge of things and their properties. And after this again comes a stage of less dependent babyhood, extending on to childhood.

The progress through the whole period of Babyhood may be indicated by some of its characteristic events. The baby is three months old before he can do much at holding up his head, and four months old before he can grasp effectively at what he sees. By the sixth month he gets his first tooth, and perhaps begins to imitate and to know his own name. By the seventh month he has learned to sit up. By the eighth or ninth month he is being weaned. By the ninth or tenth he may be creeping; by the twelfth he is standing and perhaps making his first attempts at walking, and beginning also to master a few words. By the fifteenth or eighteenth month the soft pulsating spot on the top of his head, the fontanelle, corresponding to the unclosed opening through the skull, is finally closed up. By the twenty-fourth to the thirtieth month he has the last of his first set of teeth. By the thirty-sixth month he has perhaps shown both his powers of locomotion and his independence by running away.

The mental development taking place through this period is at first so largely a matter of getting the use of the sense organs and the muscles that it is hardly possible to treat of mental growth apart from physical; we shall therefore ask no pardon for presenting a number of physical details. The *new born* baby comes into the world not only considerably out of proportion when measured according to adult standards—too big in the head, too small in the chest, too short in the legs—but also very far from complete, physically. His muscles are weak and not under his control; his eyes do not move together, he cannot look where he will, very likely he cannot see color at all. His ears are stopped. His nervous system is ready for its work in the parts necessary for maintaining life, but very little so in those that furnish the basis for preception and voluntary movement. He has then, and has had for weeks his full quota of brain cells as to number, but many are as yet too little grown to be of much service. He will be nine months old before his brain in gross organization, even, is like that of an adult. In all probability mental growth must often wait for the development of the necessary cells and fibers of its physical substratum. It is small wonder, then, if his mind is practically non-existent. He can have had as yet but the vaguest and most unconnected sensations, if he has had any at all. He has none of the apperceptive groups by means of which things are perceived and understood. Or to put the same thing in other words, he has not yet had the experience necessary to give meaning to his simplest sense impressions. His eye rests upon a bright spot of sunlight:—he does not know it is light, nor its size, nor its distance; it is neither here nor there to him; he does not know that he sees, he does not *know* anything. He just receives an excitation—and that passively—and dully likes it or dislikes it. He is not alert mentally, either. His waking condition can not be very far from the sleep condition in which he passes so much of his time. As Professor James[1] remarks: "Prior to all impressions on sense organs the brain is plunged in deep sleep, and consciousness is practically non-existent."

And even when an ordinary excitation does penetrate to the slumberous little consciousness, the utmost response which it awakes (to quote Professor James again) is best "expressed by the bare interjection 'lo!'" —except, indeed, in the case of pains or sharp discomforts which doubtless make a more intense and voluminous, though probably no more distinct, impression. The story is told of a young mother who brought in her bachelor brother to see the new baby asleep in its cradle. Among the other things she asked if he didn't think the baby was very intelligent. He said he did n't feel himself altogether a competent judge and asked what the baby did that was so intelligent. The mother exclaimed, "Why, you great stupid, don't you see how intelligently he breathes!" The mother did n't miss by far the baby's highest pitch of intelligence.

In a somewhat more drastic fashion we may bring ourselves to a realization of the mental state in early babyhood by remembering that idiots and imbeciles are cases of "arrested development." I do not mean to say that in any case the idiot has simply stood still where he stopped; but, making all allowances, it is simple fact to say that any baby stopped mentally during his babyhood would be an idiot or an imbecile. What I have just said is indeed true, but there is an abysmal difference between the two in that for one it is a healthy stage in progress toward full growth, and in the other, a permanent abiding place.

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[1] Psy. II, p. 7.

And the new-born baby begins to grow at once. Whenever he is awake, sensations pour in upon him and by degrees are knitted up into the tissue of his gradually forming mind. If he is at first, as to his mind, *tabula rasa*—an unwritten page—it is not an absolutely uniform page, but one rather on which the ink will flow much more readily in some directions than in others, and in which certain general outlines will, in the usual course of things, be almost sure to take shape. There are certain growth tendencies somehow latent in the nervous system, and there are certain experiences which the baby's human body and his situation in the midst of a human family are sure to bring him; and these growth tendencies and human experiences, between them, see to it that his mind shall grow up into something that we shall recognize as a human mind.

Let us take as a typical instance the development of voluntary control in the arm and hand. Every one is familiar with the vague convulsive movements so characteristic of little babies, the throwing about of the arms and legs, the grimaces, and the wrigglings of the fingers. They are at first purely spontaneous, made without the baby's intention, very likely at times to his great surprise, by an involuntary discharge of his unstable nerve centers, or as an overflow from other centers actively stimulated. They belong to the early stages of babyhood, and gradually disappear as voluntary movements are established. They owe their importance, indeed, to the fact that they pave the way for voluntary movements. In order that a child should make a movement voluntarily he must know how it feels, and this the spontaneous movements teach him. They also furnish a great mass of partly organized movements from which certain preferred ones are selected.

One of the most characteristic of these early arm movements is that of bending at the elbow and carrying the hands toward the face—really a return to the position long occupied by them before birth. As the hands are brought up in this way they now and then wander by accident into the mouth.

At this stage the mouth and tongue are the leading organs of grasping and touch, and the sucking movements among the readiest that the baby possesses. Anything brought to the mouth is sucked and mumbled with the greatest enjoyment. His pleasure is often assumed to be a pleasure of taste, and babies are set down as little gourmands, whose chief delight is eating; while it is probably the fact that what they are really enjoying are the muscular pleasures of sucking and the tactile pleasures of feeling of objects with the lips and tongue. When the hands come into the mouth in the way just described they also are sucked and mumbled like other things, and perhaps give rise to an especial pleasure because of the double touch sensations—in both mouth and hand—that are then experienced. At any rate the pleasures which the baby gets from this happy coincidence of hand and mouth put a premium on the repetition of the movements that produced it, and the baby is soon found to be bringing his hand to his mouth voluntarily. By the middle of the third month, perhaps, the baby has mastered the movement, and specialized upon the thumb as the most convenient part of the hand for sucking. But the hand is not yet recognized as a part of the same person as the mouth, and the baby is often astonished and disappointed to find that he cannot throw his arms about and go on sucking his thumb at the same time. The mouth is a grasping organ as well as a tactile one, and at this time the baby dives down with his head to capture his thumb quite as much as he raises his arm to bring it to his mouth.

The next step of advance comes from the side of the hand-movement. From the very first the baby's hands have tended to close reflexly upon whatever has come in contact with them —a survival, very likely, from the arboreal ancestors of man, and a time when it was a life-and-death matter that a baby should cling tight to the hairy body of its mother and leave both her hands free for fight or flight. (That this is not altogether a biologist's dream is made very probable by the fact of the baby's greatly advanced development in arms as compared with legs, by his early ability and passion for climbing, and by the experiment of Dr. Robinson, who found in many babies tested by him an ability to hang by their hands from a supporting bar far in excess, apparently, of their ability in most other directions.)

This reflex mechanical closure of the fingers upon objects with which they come in contact leads in the natural course of things—and, as before, quite without the baby's thought or intention—to the carrying of things clasped to the mouth, along with the hands. New pleasure results from the oral investigation of these things, and by the end of the third month the baby is found to be making deliberate efforts to carry things to his mouth.

In the meantime the touch sensations of the hand itself have not been running wholly to waste, and hand-grasping has gradually become more skillful. Objects are picked up when they touch the back or palm of the hand, and are fumbled for in a blind way under guidance of touch alone. It is nearly a month more—say the end of the fourth month—before they come under the control of the eye. There is a time, indeed, when the eyes look on at the fumbling hands with interest, but without assisting them. Even when thus guided, the grasping for a time is still in the interest of the mouth; but the manual part improves as time passes, until by and by, perhaps toward the end of the fifth month, objects begin to be grasped in order to be handled and pulled about, rather than to be carried to the mouth. In the next month the pleasure of manual manipulation is great and mouth-grasping and its pleasures are on the wane, and so the carrying of things to the mouth becomes infrequent. By the ninth month hand-grasping is so perfect that the baby may be found able to pick up pins or to amuse himself in playing with a single hair.

Along with this increase in motor skill has gone an increase in the power of tactile discrimination, a growth and refinement really of a crop of tactual ideas; and in the tenth month the forefinger begins to take its place as a special organ for delicate touch investigations. Upon this follows still later another stage of development—interesting because it carries us over into another field—that of gesture language. The forefinger, having become a special organ for investigating-touch, is stretched out and applied to objects within arm's length, and, by an easy step, toward those that the baby would like to touch; and then (perhaps supported by the still earlier gesture of holding out the arms to objects of desire) it comes to indicate objects desired and finally any object, thus ending as the usual indicative gesture of the pointing finger.

In brief review, then, we have the hand carried to the mouth first by spontaneous movements, then intentionally. Its reflex grasping brings objects with it to the mouth, at first accidentally and then intentionally. Its reflex grasping gradually goes over into intentional grasping under the blind guidance of touch alone, which later yields in part to that of the eyes, (the sensations of the wider visual field coming to serve vicariously for its own more restricted tactile sensations). The growing refinement of its own tactile sensations leads, however, to the selection of the forefinger for tactile investigation, and the organ thus selected is by and by pressed into the service of communication.

There is not time to go into detail in regard to these matters, nor to recount through what stages the art of seeing or of walking is developed, or how the babbling voice-play of the baby becomes articulate speech. We must leave details with the typical case already given. But there are other general characteristics, especially of the later part of the period, that we must give a word to.

The baby's chief business, after getting some sort of control of his sense organs and muscles, is to learn something of the properties and peculiarities of things about him. He begins this, indeed, a good while before his control of these organs is by any means perfect. Everything must be seen, touched, tasted, handled ; he must do everything he sees others do ; he must investigate. He may take off the top of a can and put it on a hundred times running, and as long as he does it he is probably learning something from it. When a baby keeps you busy picking up his rattle, which he drops again as soon as you give it to him, he is carrying on what seems to him an interesting game, but he is also learning in a practical way something about the law of gravity and how things behave when they are left unsupported. That he does so unintentionally and in the form of play does not alter the fact in the least. Sometimes the learning is wholly accidental, as when the baby touches the stove or tips over the ink bottle ; but in accidents again, as much as in play, he is learning. He goes to school all the time he is awake, and learns for the most part not only with interest but with the utmost zeal and enthusiasm.

He is not a very concentrated student, however. He is interested in everything, but in nothing long. As one writer has phrased it, his attention is very easy to *obtain* but very hard to *retain*. Emotionally it is just the same ; he is "pleased with a rattle and tickled with a straw," but cares for neither for very long together. On the other hand he is extremely conservative and will come back again and again to the same rattle and the same straw. In some things he is even the abject slave of habit. He cannot go to sleep without a feather to tickle his lips and nose with, or without the corner of the same blanket to suck. He is light-hearted unless he is ill, but is easily moved to tears. He is fearful of unfamiliar things (as he needs to be in a world of things evil as well as good) but much attracted also by whatever is new (as he needs again to be, if he is finally to know and master his world). He is affectionate but not loyal (he will forget his own mother in a few weeks). He is easily angered, but not resentful. He is largely self-regardful, as both his needs and his training dictate that he shall be, but he will cry if harm is threatened to those he loves. He is impulsive ; his powers of control are low ; he is an easy mark for slight temptations ; he has no stability of will and no constancy of purpose. What he obstinately refuses to do now, he may be quite willing to do in the changed mood of a few minutes later.

All this inconstancy of feeling and instability of will come from the same causes. The little child (and still more the baby) lacks the fixed habits of thought and feeling (in technical language, the apperceptive masses) which put the solid frame-work into adult mind and character.

For a similar reason a little child is apt to be less surprised than an adult at the tricks of a sleight-of-hand performer, because the tricks do not seem much more wonderful than many other things he sees. As far as he knows, it may be as easy to take rabbits out of a silk hat as it is to make flour and eggs and butter and sugar into a loaf of cake. He is impressed equally by *all* such things because he has not yet the habits of thought that make one set of phenomena extremely strange and incredible, and the other quite ordinary. He has also a very inperfect idea of consequences, because he yet lacks experience. All psychical development from babyhood to old age can be summed up in terms of these two things—a growing complexity and fixity of habit, adjusted to remoter and remoter contingences, and all formed under pressure of experience. Of course babies differ enormously in all these things; what I have said may be only partially true of any one particular baby. But there yet remain enough points of similarity to give us a pretty definite set of ideas when the word is mentioned,—and some of these I have enumerated.

Toward the end of the babyhood period the baby is fairly familiar with the common properties of the things about him: he can walk and talk as much as he needs. He will make the coarser adjustments, keep his fingers out of the candle-flame, drink his milk, go to the kitchen when he wants a cookie. Psychologically he has become too complex, too active, and too observant for complete and overt observation and note-taking; he has "become as one of us to know good and evil." His progress after this is less and less unlike the progress of adults.

With the end of his third year he passes out of babyhood and into childhood—the age of general mental adjustments as babyhood was that of physical adjustments. It is the great habit forming period. In its earlier part it is a continuation of the learning of bodily control, of language, and of the properties of things and characters of persons, already begun in babyhood, together with the beginning of moral and social requirements, obedience, clean hands and face, "yes, ma'am" to ladies and "yes, sir" to gentlemen. In the latter part it is the school age—the time when society seizes upon the boy and forces him to learn the indispensable conventions of modern life, reading, writing and ciphering. It is the age of "the whining school boy with his satchel and shining morning face, creeping like snail unwillingly to school." (The limit of the period is sometimes recognized in legislation. The compulsory education law in Massachusetts, for example, requires that children attend school till they are fourteen years old.)

As these differences indicate, the whole period falls apart readily into two sub-periods: early childhood, extending from three to about seven; and later childhood, extending from eight to the beginning of the adolescent changes at about twelve for girls and fourteen for boys, with a year of instability and change lying at seven or eight between the two sub-periods.

The importance of the turning point at about seven years is really very great. At that time the brain reaches nearly its adult size and the direction of its development probably changes. From birth to about the seventh year the cells have been growing toward their final bulk and form; after seven years, growth is probably in their finer intercommunicating branches—in the organization of the brain substance rather than in increase in mass.

A remarkable fact with regard to the dreams of the blind seems to point to the existence of a line of demarkation at about this same time. It is this: that persons who become blind during babyhood or early childhood (that is before seven years old) rarely or never dream of seeing; while those who become blind after that age do dream of seeing more or less frequently—more frequently of course as the interval between the beginning of their blindness and the seven year limit increases. It has been conjectured, with much plausibility, that the visual areas of the brain need the help of incoming excitations in order to grow up to full perfection; and, if deprived of these by the loss of the eyes before the most of their growing is done, are never able to reach the condition necessary for carrying the vivid presentation of the visual images on into later years. In order that an image may return in dreams it must not only be preserved but it must have formed some sort of associative links with other things in order that it may be reintroduced into consciousness. The perfection of the visual center probably involves the adequate growth of interconnections with other centers as well.

The falling away of the milk teeth and the coming of the permanent set begins a little before this critical time.

Let me characterize the two sub-periods a little more fully. The first is the period of Early Childhood. It is a period of somewhat rapid growth and change, though less so than the period of Babyhood. At three years the child has something over half his adult stature and at seven years more than two-thirds. He has still a good deal to do in getting control of his muscles; he is clumsy, especially at first; he tumbles down easily and often; he cannot throw or catch a ball very well;

fragile things are unsafe in his vicinity; if he has a knife, he cuts his finger. He can manage his sense organs with some skill, but he has yet a good deal to learn of the more refined and inferential use of them. He is probably not at home in the conventional ways of representing solid forms; he does not fully understand perspective drawings, nor the meaning of light and shade in pictures. His visual world itself is limited to things near the ground. He does not look up much, nor look far away.

Mentally he is growing continuously in complexity of thought and reaction under the guidance of several strong and important instincts: the instinct to investigate, to ask questions, to experiment; and especially to imitate and to play. He lives the life of the senses, simpler motor activities and imagination. His mind is active and he has not as yet the experience that corrects illusions, nor the critical attitude that dissects them; he is readily open to suggestions. He is fond of stories and they appeal to him powerfully, but they must be of action, with clearly marked ethical import. The prince must always slaughter the giant and marry the princess.

How narrow the experience of a little child really is and how little he knows outside the world of that experience is strikingly shown by the studies of the contents of children's minds on entering school, *i. e.*, when near the end of this first sub-period. In the tests made by Dr. Hall some years ago on Boston children, for example, more than half did not know their own wrists and ankles by those names and not more than one in five knew that they had hearts, lungs or ribs; one in five did not know right hand from left; about one in seven did not known the stars and even one in fourteen or fifteen did not know the moon. Over nine in ten did not know that leathern things came from animals, nor the origin of cotton things. Over eight in ten did not know what flour or bricks are made of, seven in ten did not know the shape of the world, and almost that proportion did not know the origin of woolen things. Half did not know that wooden things are from trees and one in five did not know the source of milk. Few children have any mathematical knowledge extending beyond four. And finally what knowledge they do have is scattering and unsystematic. This is of course toward the end of the sub-period; at its beginning, they are ignorant of almost everything not lying immediately within their own experience and frequently brought to their attention.

This is all natural and as it should be. The child is yet laying the foundations of knowledge and his range of facts is not especially important. He is getting his knowledge at first hand and working it up into habit and fixed forms of reaction.

He is also gradually laying out the lines of what will be his habits of standing, sitting, walking, speaking. His temperamental tendencies are showing themselves more and more clearly, and in the interaction between these and his surroundings his moral qualities are also beginning to take shape—his attitude towards difficulty and toward authority.

His moral standards are as yet borrowed from adults and often shifting, but he is coming slowly to feel that some things can be done with good after-effects and some cannot. He has much to learn; he has, for example, no native modesty, and little idea of the property rights of others, or indeed of any rights of others at all. He may often exhibit a curious mixture of affection and selfishness. A story runs of two little fellows, whom I may call George and Charlie. One evening George and Charlie came into their nursery at supper time and found only one orange set out upon their table along with the other things. Suddenly George burst into tears. The nurse tried to comfort him and asked him what could be the matter. He replied between his sobs: "There isn't any orange for Charlie." Childish morality is not and ought not to be a replica of adult morality. If the child is making progress toward truth-telling, obedience and kindliness, it is all that should be asked. It is not, however, a time when parents and teachers may be neglectful. The more fundamental habits, both physical and mental, are slowly forming under the guidance of precept in part, but infinitely more through imitation and the all-moulding influence of environment.

Most of the little child's waking time is spent in *play*, and perhaps we could not characterize the whole sub-period better than by calling it the period of simple play—pleasant, spontaneous, unorganized activity both of mind and body, but leading by the most direct route to the formation of such general habits of body and mind as I have just mentioned.

In this period begins also what is to be the chief characteristic of the following sub-period: the child begins to go to school. In the earlier part of it, even, he may enter the Kindergarten, and by the latter part he really starts in upon the process of formal education; but the pedagogical principles of the time should be borrowed largely from the previous and not from the following stage. The chief one should be "non-interference." See that the child has unlimited opportunity; keep him from getting set in habits that will hinder him later; and let his spontaneity do the rest. These two points alone will furnish the intelligent parent and teacher with all he will care to do.

With the transition into the period of later childhood comes more or less physical change and disturbance. The child at seven or eight is often more easily fatigued than he is at six or nine; and may be more or less upset. One student of the period is inclined to believe the extent of change at this age as great as that which at twelve or fourteen marks the beginning of adolescence.

After the transition-time comes the sub-period of later childhood from nine to twelve or fourteen. This is the school age *par excellence*, the time for learning things. Physically the period is one of steady growth, though the rate is probably not so rapid as during the transition-period preceding it and certainly not so rapid as in the one following it. The balance of physical functions is good. It is a time of health and small liability to disease. The coarser muscular adjustments are now well in hand and the finer ones are rapidly coming under control. It is the time for beginning practice upon musical instruments, for manual training and the like.

And the boy is in a similar condition mentally; he has most of the general information that he needs for daily use; his powers of attention and his mastery of language are sufficient to allow him to take up more difficult and abstract studies. He is solidified enough now both in body and mind to *work* in earnest—not in excess of course, but certainly to do some things that are not pure play. The boy who does not learn to *work* now misses one of the best things that can be taught him at this stage. It is the time for learning multiplication tables and paradigms and whatever else comes only by drill and drudgery. His powers of reflection are not as yet very far developed and he is better for learning tables and rules than for dealing with abstract principles. In feeling he is self-regardful, though not so unrestrainedly so as earlier. His self-control and persistence are only moderate. His will is not yet very strong. His social feeling in general is small (he is apt to be a tease and tormentor of those about him, and a depredator of orchards), but with reference to his particular group of companions he may be very faithful. His plays now begin to be co-operative (*i. e.*, team plays, a great advance upon the individualistic plays of early childhood) and games are played in which rigid subordination to the rules of the game are required—both involving valuable lessons for those that engage in them.

In the latter part of the time "gangs" develop and the boy's hand may seem to be against society in general, but society does not fail to exert an immense influence upon the boy in spite of himself. It provides the general atmosphere in which he grows up and from which he can never escape. He breathes in the war spirit in times of war (even in early childhood) and later gets a bent toward sport from the popular interest in football or pugilistics, or yachting, or in many less tangible matters.

In conduct and morals as well as in other things, it is a time for drill. Discipline must be intelligent and adapted to the nature of the subject under training ; it must be sympathetic, but it must also be vigorous. Work must be well done ; reasonable requirements must be fulfilled to the letter, or habits of slipshod work and unreliability are likely to result.

If I should attempt to sum up the sub-period in a single word I do not know that I could do better than to use the word "boy" without modification or adjective of any sort. Whatever that word conveys to you belongs to this period. At the end of it, say at fourteen years, his adaptation to his surroundings is tolerably perfect. He can ride, skate, swim, dance, play tennis, baseball, football and other games, and do what he will with his body (barring a few feats of special strength or skill). He knows how to take care of himself in his own town, knows where to get what he wants. The period is one of such complete and happy balance as to lead an eminent lecturer on adolescence to suggest that it corresponds to a long stage in racial development when the race fitted fairly well with its surroundings and solidified its attainments rather than advanced by rapid strides; and the superficial resemblances between the wild life of the savage and the instinctive hankerings of the twelve or fourteen year old boy are too plain to have escaped frequent remark.

I have spoken so far of boys alone. In babyhood and early childhood there are probably few differences between boys and girls worth considering. In later childhood differences probably appear, and would very likely repay careful study. In the next period they become marked.

Adolescence.—The next period, that of adolescence, or youth, extends from the close of the period of childhood to that of physical maturity at about twenty for young women and twenty-five for young men. The period is ushered in by a time of rapid physical growth—really a transition period between childhood and youth proper. This begins earlier, as I have said, in girls than in boys, and the girls being but a little inferior in height and weight at the start, soon surpass the boys and for two or three years are both taller and heavier. By the time they are fifteen or sixteen, however, the boys have begun their stage of rapid growth and are soon in the lead again, and so continue for the rest of their lives. The rate of growth falls off by degrees and becomes very slight towards the end of the adolescent period. At the ages specified it is practically at an end, though there is some reason to think that in the case of men the stature may go on increasing up to thirty-five and the weight even after that time, though in the latter case it is gain in fat and not in the effective size of the organs. Soon after the beginning of the first rapid growth the characteristic changes begin in the organs of sex, attended and followed by the various secondary changes, both physical and mental, that go with physical maturity. The figure fills out, the voice changes, the beard starts, the masculine and feminine differences in mental attitude gather distinctness, and the boy and girl bloom gradually into manhood and womanhood. The whole period of adolescence is one of transition and is marked, as such periods often are, by maladjustment and general disturbance. And like such periods, again, it is of great importance. It is a time when the most powerful influences are at work both within and without, when the youth receives his racial inheritance and comes into his full estate as a man. What is not accomplished now in the determination of personal qualities or in the grounding of character, runs small risk of being accomplished later. The decisive nature of the period is recognized by savages in their ordeals and other rites of initiation into full tribal standing, and among ourselves by placing the age of majority at eighteen for girls and twenty-one for boys.

The changes occurring during this period affect all relations of life. I shall speak briefly of a few of them.

First *Physical Changes*. I have already spoken of the rapid growth at first and the specific sex changes, but these are by no means all. It is the last upward sweep of the powers of physical growth. New physical inheritances seem to come out, and a boy or girl who has resembled one parent may now grow to look more like the other; or family diseases may appear, insanity or tuberculosis, which, if not directly inherited, now find the system less able to withstand their attacks. Yet in spite of the tendencies and in spite of the troubles arising from the temporary lack of balance in the growing organs, youth is a time of high vitality; there is energy for anything—physical or mental. The energy, however, may not be well co-ordinated. In the earlier stages the youth is clumsy; he has n't strength proportionate to the size of his muscles; he has n't himself in hand. Or he may take up with some one-sided idea of life or theory of reform and hold it with a devotion out of proportion to its importance. But he has the energy, and the lack of balance passes away in time.

The characteristic sports of the adolescent stage are mostly team-plays as in later boyhood, but are carried on with more vigor and success, and toward the close of the period are pushed to the limit of strain and intensity, *e. g.*, college football, baseball and boat racing. Others, again, introduce an element of single combat, like boxing and the German student-duels. Such sports can flourish only at a time when the physical powers both of endurance and control have reached a high degree of perfection.

Profound physical changes like those of this period can hardly take place without involving equally profound mental changes. One has only to think of the way in which his own mental world may change color in seasickness and recovery from it, or even from the alternation of rest and fatigue, to see reasons for all kinds of glooms and rose-lights in the world of the adolescent. Of these I shall speak more fully in a moment. I wish to speak first of his more intellectual characteristics. It is a time of great mental awakening. The youth's powers of reasoning and attention are developing rapidly. He has now many of the groups of apperceiving ideas (the distilled essence of experience), by which he can take in and react upon some of the larger problems of life. His eyes are opening, he begins to meet in his reading and in conversation with the ideas that have stirred the world. His course of study brings him to the Greek tragedies, the Roman Empire, the Renaissance, the Reformation, modern science—is it any wonder that the thoughts that stirred men at these periods, though coming distantly now and from the printed page, should cause an intellectual awakening in a mind that comes to them fresh and for the first time? He hasn't yet the balance and poise that he will get later; he takes these things in a one-sided way often, and runs up some parts of his intellectual building much faster than others. His interests and likes and dislikes may be quite unstable; he may be something of a faddist, now interested in one thing and now in another, but such a symptom is not fatal nor even bad, if he outgrow it in its time; for in the end he will go into his chosen field carrying some spoils from all upon which he has entered.

It is not so much these, however, that give the characteristic color to the mental life of youth, as those that root in emotion. This is the age of Jaques's "lover sighing like a furnace, with a woeful ballad made to his mistress' eyebrow," and it is true that in this stage the boy begins to notice the girls in a little different way and perhaps to take a little more pains with his dress and manners; he may have his first love affairs—transient and numerous and mostly innocuous. Often he is drawn toward a lady much older than himself, who may indeed understand him better and be kinder to him than the girls of his own age would be likely to be. And the devotion which a sixteen year old boy sometimes gives to such a woman is more like worship than anything she is likely to receive from older lovers. Something similar happens to the girls as well, and the passion of devotion is at times so strong as to take on aberrant forms. Young girls in college it is reported at times develop passionate attachments for persons of their own sex, some instructor or fellow student,—a relation which, while it may promise something of pleasure, tends, if it go too far and last too long, to be decidedly unwholesome.

But these romantic feelings are but a part of the emotional life of the time, and Jaques has as usual picked out a single feature in order to heighten the effect of his picture. The general social feelings are much strengthened. Lifelong friendships are formed—there are no friendships like college friendships, it has been said. Altruistic emotion strengthens, and to many a boy the vision of a life of self-sacrifice for the general good comes like a Star of Bethlehem. Life at this time is taking on a new meaning, and in the intervals of his activity the youth dreams out his own future and forms his ideals. It is a time of aspiration. It is the time in which George Eliot describes Maggie Tulliver as feeling a "wide hopeless yearning for that something, whatever it was that was greatest and best on earth," and of which Longfellow sings, "A boy's will is the wind's will, and the thoughts of youth are long, long thoughts."

It is a time of hero-worship also—sometimes real people, sometimes imaginary ones. It is the time for day dreaming, for air castles, for romance, for ideal literature in poetry and prose. The day dreams and ideals are sometimes impossible; they are often crude; they are always inexperienced; but they are not therefore fair targets for ridicule. The boy of sixteen may be doing a deal more of serious thinking than he gets credit for. He realizes his inexperience and the crudity of his thought, and he is eager enough for something better, but he hates to have what he has taken pleasure in laughed at (or even smiled over), and so does n't talk of it. As he advances in age his ideas become more definite and tangible; he gets down toward reality, and in the end experience furnishes all the correction necessary. Perhaps too much! At this early age he is ready to put his ideals into practice; he may not be later. It is the youth, who, "When Duty whispers low, 'Thou must,' replies, 'I can.'"

At this time also religious and moral questions come to the fore. Statistics that have been gathered show that the adolescent period, especially its earlier part, is the natural time for the rise of religious feeling. Most conversions occur at that time, and confirmation is administered at about that age by those churches that make use of it. But the development is not always smooth. The boy begins to hear questions raised about the moral code that he has accepted so far on authority or under compulsion; he learns of other theologies than that he has heard from the local pulpit. He feels the need of settling these things for himself, or feels perhaps the simple impulse to assert his independence, and the result is that theologies and moral codes go themselves into the fiery furnace. If those which he has been taught have been foolish and if the youthful spirit itself is a fiery one, they have small chance of coming out except as ashes; and even if they have been right and sound, but have been foolishly and dogmatically presented, they will be saved "so as by fire." But not all spirits are thus fiery and not all teaching needs revision. Many come through their youth with no very serious storm and stress period, and gradually find themselves realizing in earnest the religious experiences that they have heard vaguely spoken of before. The real safe guard against the more uncomfortable sort of experience first spoken of is home teaching which does not insist on non-essentials. The way to make a wreck as complete as that which overtook the "one hoss shay" is to make every part of your creed exactly as strong as every other part. And the real guiding star for those who are themselves in such a state is the *steady habit of right conduct.* Those who can keep their feet on the path of daily right living will find their theological skies clearing of themselves, and that before long.

But the boy himself is only half the story. He is not only different himself but he begins to be treated differently by others. Much of the hobble-de-hoy condition comes from the incompleteness of his fit into society. He puts on the modern *toga virilis* of long trowsers and a tailed coat, and people begin to call him "Mister." He goes to parties where he does not know quite how to behave, and makes calls which he does not at all know how to terminate. Much of the difference in others' treatment of him is quite unconscious — brought out in others by his increasing stature and general development; but new things are expected of him and he responds to them, and thus action and counteraction work him along till his estate is fully recognized on both sides. Unfortunately, however, those nearest him are often slowest of all to recognize the change. (If Ponce de Leon had only examined the opinions which his kinsfolk and elders entertained of him he would undoubtedly have discovered his fountain of immortal youth). And even when his elders do recognize the new conditions in some degree, their treatment of him is apt to be uneven. At one time they require a man's behavior of him and again treat him like a boy. This is naturally more or less exasperating and unsettling, and it is often by no means a bad plan for a youth to go away from home at this period, and stay away until he can come back without the limitations of others' recollections of him. It also satisfies the strong cravings of this period for an independent life. Even boys in homes that they love feel it. It is the *Wanderlust*—to get away, to join the army, to run away to sea, to see the world, to have some experience. It is the same feeling in another form that leads to the intellectual independence already spoken of. And it is a wise parent who can trust his own early training of the boy and remember, when he sees his son apparently drifting away from him, that the separation is a natural process of growth, and that if the training has been sound the boy will in the end return no less loyal than before and the richer for his knowledge of his own powers.

Another way in which society contributes to the peculiar character of youth is by keeping the boy away from action and responsibility, and shutting him up, as it were, until he is old enough to take his part in the real business of life. This, it seems to me, is responsible for the major part of the dreaminess and the mental "mumps and measles" of this period. These soon disappear under the touch of reality, and, I fancy, do not much bother those whose circumstances bring them early into active participation in affairs. It is hard work learning to swim when one is kept for the most part away from the water.

At the end of this period—at twenty-five—the young man is physically perfect, trained for his life work (as far as general training goes), and, though largely inexperienced, is eager to enter upon it. If I should try to characterize the period briefly I might say that it is the tuning of the orchestra; it is the opening of the flower and the promise of fruit; it is the declaration of independence; it is the new birth. If my figures seem mixed I can only reply that so is the period.

Young Manhood. The stage that follows is that of young manhood. It is the time which Jaques assigns to the soldier:

> "Then the soldier,
> Full of strange oaths, and bearded like the pard,
> Jealous in honor, sudden and quick in quarrel,
> Seeking the bubble reputation
> Even in the cannon's mouth."

It is the time for action. The young man is full of energy; he is capable of much hard work; Chicago is said to be made by men under forty years old. It is the age of the under officers in the army and navy; young men for war, old men for counsel. It is the time when the young business man is getting his experience, laying up his capital and winning the confidence of his business acquaintances; the Napoleons of finance are said to be for the most part about forty years old. It is the time when the young professional man is laying the foundations of his professional success in law and medicine, and while these may not be "full of strange oaths" and bearded like panthers, there are also other haunts of "the bubble reputation" than the cannon's mouth. There is said also to be a "dead line" for clergymen at forty, beyond which they are not likely to receive flattering calls to large churches. It is a time of hope—the world, at least at the beginning, is almost untried; anything may be possible. Even a modest young man may hesitate to say how high his star may not ascend. His natural force is not abated; he can pay the price of success; late hours either of work or dissipation can be borne. Indeed it is one of the first authoritative signs of middle life when the young man or woman begins in earnest to think much of to-morrow's lassitude in connection with to-day's pleasure. As a whole the period is one of hard and eager effort and of many lessons in the strenuous school of experience. In this period in the usual course of events a young man falls in love more effectively, and undertakes the support of a wife and family, and often carries with a light heart the double burden of business cares and anxieties for growing children. In a woman's life the corresponding period comes a little earlier. It is the time when the care of a family of little children takes all her time and energy; or if she be earning her own living, when she also is making her professional reputation as musician, artist, teacher or philanthropist. I fancy also that it would be found that many of the women active in the management of church or social affairs are of about this age—though not exclusively nor even predominantly perhaps, for there comes later an Indian summer period when women are often freer to undertake such things.

At about forty, the close of this period, we have another stage of transition, a sort of a second adolescense it might be called, when the young man puts off the "young" and becomes man pure and simple—the adult on the threshold of middle age. This second adolescence is not often so marked as the earlier one. A man of forty is less open in the expression of his feelings and there are fewer competent observers. Those who are younger think that grown up people are all rather beyond the point of feeling at all. (I fear myself, that if I were to press the question home upon you, you would be obliged to confess that a person of forty seems to you rather staid and old—in fact hopelessly adult.) And those who are older do not notice, or think it but natural that advancing years should make a change. But those who stand nearest to a man between thirty-five and forty-five will be pretty sure to see the change, if they look for it. It shows itself more in his active powers; he becomes little by little less aggressive than he used to be. "Up to forty a man seeks pleasure, after forty he flies from pain," sings an observant poet; and a few weeks ago I heard the same sentiment confirmed in the conversation of a couple of electric car employees when one of them said to the other, referring to a recent railway accident: "A man beyond forty ain't got no business to jump trains."

There is physical ground for the change. By this time the forces of growth are fairly expended; repair goes on but there is no enlargement. Under forty a weak heart may grow to compensate its weakness—so the doctors say; but after forty not; and this is true of the physical powers in general. A man is not now able to stand so easily either the hard work or the dissipation that he once could bear with ease. He is more apt to count the cost. And for this reason the most likely time for reform in drunkards is not in young manhood when their physical powers and courage are high, but in the early part of middle life (about forty-five, say) when their physical condition is beginning to deteriorate and they feel and foresee the full effects of excess.

But there are also mental causes. Up to thirty-five or forty a man feels, as I have said, that life is not all tried; that it may yet contain much that is new and delightful. He feels that he does not know his own powers fully; there may yet be capacities in him that he has not discovered and that may yet realize his dearest ambitions. Up to that time he has been exploring his social and intellectual world as a baby explores his physical world. By forty he knows it pretty well and has taken the measure of many things in it, especially of himself. The chances are large that he has tried something important and failed flatly, or he has had occasion to look back and estimate the small progress he has made in realizing his ideals of ten or twenty years before. He cannot hide from himself that many things of which he has been casually dreaming are entirely and forever out of his reach. He wakes up with a chilly feeling to the recognition that his boyhood is past and that what he is to do he must do quickly, and sees at the same time how extremely hard it will be for him to advance far beyond his present standard in originality of work, however much he may increase its quantity or erudition. Such a time of disillusionment, if it be acute, cannot be passed through without something of humiliation and mental pain—but as in the case of the other periods of transition, time brings the man through it.

The severity of the experience will depend on the temperament and on the circumstances of him who is undergoing it. Here as everywhere the chief preventive and antidote of personal disappointment and suffering is to be interested in something or somebody else. Disappointment and disillusionments come even then, but they have not the sting that makes foiled personal ambition so bitter. Those who are married and have children, have a great and natural advantage here. The man who at forty has a family of children growing up around him finds his own ambitions transmuted by almost insensible gradations into ambitions for his children. As he learns his own limitations he lives again in their undetermined possibilities, and as Shakspere says, "sees his blood warm when he feels it cold." But even if he is not so happily situated, time and good sense carry him through. He comes again to a happier view of life, content if he may succeed in doing well what yet remains for him to do, and finally settles down for the best twenty years of his life for intellectual work. In adaptation to his environment he is like the boy; he knows his world and his powers; and though he may work now with less ambition, he works with well-knit habits of industry and the experience and skill of a veteran. Now character is fixed, if it ever will be; the feelings are still strong, but restrained and concentrated; the will is firm; people take him seriously; he finds that he has influence—perhaps to his own great surprise at first. It is the age of the judge in Jaques's sketch. The man is *adultus adultissimus*. He is at the age in comparison with which all the rest are estimated.

Period of the Elderly.—Upon this period follows that of the elderly (55 or 60 to 70), the period in which physical decline is unmistakable. Intellectual vigor may survive (and as sometimes happens, much more than compensate the failure on the physical side), but a man must take care of himself; he must retire from positions demanding physical strength and must have a care that his body be able to support the demands of his mind. In intellectual matters, even, he may find that he must fight his indolence.

There are physical changes at about fifty-five or sixty that may serve to mark the beginning of the period — but I fancy that these are less generally noticed by the man himself and by his friends than are matters of another sort. A man may meet with a physical or mental shock from which he does not seem to recover fully, or he may find himself crowded out by younger men, or it be only that his children's children rise up and call him grandpa; but in some way the knowledge comes.

Old Age.—By seventy all the man's physical incapacities are emphasized. The bodily tissues that before have failed of proper nourishment, now begin to show signs of actual degeneration. Weight and height grow less, the skin is dry and wrinkled, the hair scanty and white, the gums without teeth, the body bent, the hand tremulous, the sense organs, one or more of them, out of full function. The cells of the nervous system show many of the appearances that characterize fatigue in younger people, and perhaps it would not be far wrong to read the feelings of the aged from one's own feelings when nearly tired out. The mental marks are too great fixity of habit in thought, too little power of origination, and too little courage for new undertakings, a tendency (partly enforced by the exclusion of the aged from active participation in current affairs) to revert to the affairs of youth and early manhood, defective memory, defective powers of sustained effort. In many things the old man is like the child (what the child has yet to acquire the old man has lost) and needs much the same sort of attention. A natural timidity and sometimes decreased powers of judgment, lead to suspiciousness and sensitiveness. In its unhappy aspect it is as Jaques describes it: "Second childishness and mere oblivion, sans teeth, sans eyes, sans taste, sans everything." In its happier aspect it is the time of protected and lovingly tended rest, well earned after the labor of a lifetime.

It is natural to look upon this period of failing powers as one rather to be dreaded than longed for. Many a youth has settled it with himself that he would gladly forego life before reaching the decrepitude of forty years; and many a young man has thought the game would be hardly worth the candle after fifty. Many an old man also has found material for lamentation in the inevitable conditions of fourscore years.

But it is by no means necessary that old age should be wholly unhappy or terminate in "mere oblivion." More and more in our own day the old man is still active in his eighth decade. Gladstone comes naturally to mind as a striking example. Browning makes Rabbi Ben Ezra say:

> "Grow old along with me!
> The best is yet to be,
> The last of life for which the first was made,"

and Cicero in his *Senectute* tells what he believes to be the secret of a happy old age, which is in substance to be content with the pleasures and employments that old age allows and thank the gods that one is not subject to the ills of other and earlier stages. A deeper insight finds the real secret of a happy old age once more in service for others carried on till the end of life—a service which on the one hand gives perennial interest to life by making the old man a participator in the life of all those about him, and on the other surrounds him with love in return—a love that finds in his weakness and even in his final childishness, if that comes to him, not a burden but an opportunity.

My time is exhausted and I have merely sketched the course of life for you. There is not time in a single hour to discuss also the theoretical questions that surround it, but I shall have time perhaps to emphasize further a single point of mental hygiene. It is simply this: Cicero's advice to old men can easily be widened to fit all ages. If any one is to be happy he must find his happiness in the time and place in which he is, or like Alice in the Looking-Glass, he will find to his sorrow that there is always jam yesterday and jam to-morrow, but never jam to-day. And this again is but a special case of a yet wider precept. If you are to see beauty, or heroism, or romance, you must see them when and where you are, and in the things about you as they are. I do not mean that one is to see no ill in them; they are there, sometimes, apparently just to be improved; partly you must make your beauty for yourselves, but even for that you must be able to see and know it in its everyday clothes; you must live your lives where you happen to live. If you would let me, like Socrates in the *Phædrus*, make a prayer to the deity of the place before I depart, I should say: Grant unto me the seeing eye, that I may see the beauty in common things, that I may not miss a hero because he stands close to me, and that I may know that each age from first to last is good in itself and may be lived, not only well, but happily.

LITERATURE.

On the Association of Numerals. By H. OERTEL. *American Journal of Psychology*, XII (3), 1901. 261-267.

In Thumb and Marbe's "Experimentelle Untersuchungen über die psychologischen Grundlagen der sprachlichen Analogiebildung" (Leipzig, 1901) the statement is made that, in experiments where the observer is required to react to spoken words by spoken words, the usual response to a number-word is some other number-word. In the article which forms the subject of this notice, Oertel cites certain observations on numerals, made in the course of an extended series of reaction experiments, whose results appear to him to traverse the rule laid down by Thumb and Marbe.

Oertel's method was to expose single printed words to the view of his observer. The time of exposure was regulated, so that the words were visible for just 5 sec. in each case. During this time, and during the 15 following seconds, the observer was required to form associations in his own mind, in connection with the stimulus word, and then to communicate them to the experimenter. It is clear that, during this long period, the thoughts of the observer would wander more or less widely from the word presented to him. Associations that seemed to be due, not to the stimulus word, but to later associated incidents or experiences, were struck out by Oertel from the introspective report. Thus one observer, to whom the word 'seven' was shown, writes as follows: 'This is a sacred number, because the week has seven days. Seven and eleven. It is a prime number.' Oertel strikes out the words 'because the week has seven days,' on the ground that they represent a secondary association. Surely, a curious procedure! If associations of this sort are to be ruled out, the obvious thing to do is to let the observer write out his introspection as soon as possible after the formation of the first association, or to ask him to record only the first association that forms. How is it possible, under the conditions of Oertel's experiments, to draw any sharp line of division between reactions evoked directly by the stimulus word, and reactions of other kinds,—seeing that the second and subsequent associations are always also dependent upon those that have preceded? It is plain that the procedure is arbitrary in the last degree.

Oertel found in these experiments, with ten observers, that although inwardly spoken numerals and visual images of numbers occurred now and again among the associations, still only in two cases did the seen number-words call up other, inwardly spoken number-words. One of these associated number-words was actually the eleventh of the associations evoked by the stimulus word. This result diverges so essentially, says Oertel, from the results obtained by Thumb and Marbe, that renewed investigation of the associations to number-words appears desirable. But Oertel, over and above his errors of experimental procedure, overlooks the fact that there is, *a priori*, not the least reason for expecting a coincidence of result in the two enquiries; they are concerned with totally different things. In the work of Thumb and Marbe, number-words were pronounced to the observer, and he was required to answer by speaking aloud. Oertel, on the other hand, exposes printed number-words to his observers, and asks them to report upon the experiences which the words suggest. Thumb and Marbe expressly call attention (p. 14) to the fact that it is altogether inadmissible to transfer laws which hold for a determinate class of associations directly to another class: *cf.* also Meyer and Orth, Zeits. f. Psych., XXXVI, 1. K. MARBE (University of Würzburg).

Psychologie de la croyance. Par C. BOS. Paris, F. Alcan, 1902. pp. 177. Price, fr. 2.50.

This essay falls into two parts: an historical study, and a psychological analysis of belief. The author finds that the conflict between science and faith is apparent only; science presupposes belief, indeed, rests upon belief at every point. Belief, faith, is coextensive with life; it is the affirmation of our will to live. The psychological growth of belief is traced, from that which is implied in mere sensation up to that which involves a deliberate volition. The motives to faith are discovered in the deepest and most intimate recesses of organized life; it is the total self, the psychophysical union of mind and body, that believes.

W. Wundt's Philosophie und Psychologie. In ihren Grundlehren dargestellt von R. EISLER. Leipzig, J. A. Barth, 1902. pp. vi, 210. Price Mk. 3.20.

This is a clear and for the most part sympathetic account of Wundt's philosophical work, appearing opportunely on the eve of the Master's seventieth birthday. It falls into three parts: psychological principles, epistemological principles, and metaphysical principles (the latter including general metaphysics, philosophy of nature, and philosophy of mind). The book is a useful supplement to that already published by E. König in the series known as Frommann's Klassiker; we note in particular that Eisler lays especial stress upon epistemology, as König does upon ethics. The volume concludes with a partial bibliography. There is no index.

Magic and Religion. By ANDREW LANG. New York & Bombay, Longmans, Green & Co., 1901. pp. x, 316.

This book has two principal theses: the one positive, that "perhaps the earliest traceable form of religion was relatively high, and that it was inevitably lowered in tone during the process of social evolution;" the other negative,—a destructive criticism of Frazer's "many hypotheses, which are combined into his theory of the origin, or partial origin, of the belief in the divine character of Christ," and of the same author's "theory of the Golden Bough of Virgil as connected with the fugitive slave who was 'King of the Wood' near Aricia." On the former count, the impression left upon the reader's mind is that there is a good deal more to be said for Mr. Lang's theory than current modes of anthropological thinking and writing would lead one to suppose; on the second,—that Mr. Frazer has been pulverized. The final settlement of the controversy must be left to the anthropologists. In the meantime, Mr. Lang's psychology is generally sound, and his style, as always, is charming.

Dreams and their Meanings: with many accounts of experiences sent by Correspondents, and two chapters contributed mainly from the Journals of the Psychical Research Society on telepathic and premonitory dreams. By H. G. HUTCHINSON. London, New York & Bombay, Longmans, Green & Co., 1901. pp. 320.

"It occurred to me," writes the author in his Introduction, "that there were certain kinds of dreams common to nearly every one. . . And this being so, I was struck by the fact that no one seemed to have tried to find the common cause of each kind respectively of familiar dreams." He therefore set himself to investigate the subject, with the present volume as a result.

The valuable part of the work, to the psychologist, is the long (over 100 pp.) chapter on the Classification of the More Frequent Dreams. For the rest, the book is avowedly 'popular;' and the chapters on 'What Science has to Say about Dreams,' 'Their Association with Ideas of Immortality,' 'Divinations from Dreams' and 'Interpretations' are slight and sketchy. The two concluding chapters deal with the topics mentioned in the sub-title.

Facts and Comments. By HERBERT SPENCER. New York, D. Apple- & Co., 1902. pp. viii, 292. Price $1.20.

"During the years spent in writing various systematic works," says the author in his Preface, "there have from time to time arisen ideas not fitted for incorporation in them. Many of these have found places in articles published in reviews, and are now collected together in the three volumes of my essays. But there remain a number which have not yet found expression: some of them relatively trivial, some of more interest, and some which I think are important. I have felt reluctant to let these pass unrecorded, and hence during the last two years, at intervals now long and now short, have set them down in the following pages. Possibly in a second edition I shall make some small additions, but, be this as it may, the volume herewith issued I can say with certainty will be my last."

The book contains no less than thirty-nine sections, covering the widest range of interest. Seven of these (State Education, Patriotism, Party Government, Imperialism and Slavery, Re-barbarization, Regimentation, The Reform of Company Law), may be classed roughly under the heading of political philosophy; a few have direct reference to previous works,—so the Regressive Multiplication of Causes to *First Principles*, Some Light on Use-Inheritance to the *Principles of Biology*, Style to the essay on *The Philosophy of Style* ("the editor's title, not mine"), and The Origin of Music and Developed Music to the essay on *The Origin and Function of Music.* Psychology is touched upon in A Problem (obsession by melodies), Presence of Mind, Feeling *vs.* Intellect (one of the most important 'comments' in the book), The Closing Hours (consciousness in the dying), and Exaggerations and Misstatements (criticism of Huxley). The rest vary all the way from Ultimate questions, and What should the Sceptic say to Believers? to designs for painlessly disposing of lost dogs and for improving the acoustical properties of music rooms. It need hardly be said that there are many wise sayings, and many characteristically Spencerian sayings in the volume. "I detest that conception of social progress which presents as its aim increase of population, growth of wealth, spread of commerce:" so do many of us. "The primary purpose of music is neither instruction nor culture but pleasure; and this is an all-sufficient purpose:" this is like Wundt's theory of the function of æsthetics as the play of the adult. "Beauty is not attained by filling a room with beautiful things:" so one might quote at large. Very important is the statement of the part that use-inheritance plays and does not play in the author's Psychology (p. 149). And very characteristic of Spencer's contempt for history are the opening sentences of Perverted History: "I believe it was a French King who, wishing to consult some historical work, called to his librarian: Bring me my liar. The characterization was startling, but not undeserved."

The passing of Herbert Spencer from the literature of English philosophy is an event that no one, friend or foe, can contemplate without sadness. Let us hope that he may live long enough to publish a second and many more editions of Facts and Comments!

Psychology du rire. Par L. DUGAS. Paris, F. Alcan, 1902. pp. vii, 178. Price fr. 2.50.

M. Dugas, after setting forth the inadequacy of our present psychology of laughter, discusses in detail two forms of theory: that which treats of laughter qualitatively, in terms of the emotions and feelings which it expresses, and that which treats of it quantitatively, in terms of the amount of nervous energy which these various feelings and emotions release. He concludes that laughter is in every case an accident, an epiphenomenon. It is an expression of individuality, and consequently manifests as many forms as there are different types of mind or states of consciousness. Hence no single theory is possible. On the practical side, laughter may be an object of desire or aversion, but cannot be an end, an object of volition.

Causeries psychologiques. Par J. J. van BIERVLIET. Gand, A. Siffer; Paris, F. Alcan. N. d. pp. 165. Price fr. 3.00.

The author here brings together three popular and brightly written articles on psychological subjects. The first, L'envers de la joie et de la tristesse, deals chiefly with the James-Lange theory of emotion and with the views of Dugas and Fleury; the second, Le problème de la mémoire en psychologie expérimentale, devotes most space to the work of Ribot, Bourdon, Binet and V. Henri; the third, Les formes de passage en psychologie, seeks to show the relation between the normal condition of the mind and certain well-marked pathological phenomena, such as hallucination, suggested movement, and double personality.

A History of English Utilitarianism. By E. ALBEE. London, Swan Sonnenschein & Co.; New York, The Macmillan Co., 1902. pp. xvi, 427.

Professor Albee has produced a notable work, and one which will be of high value to psychologists as well as to students of philosophy proper. Hitherto we have had no history of English ethics worthy the name: Whewell's *Lectures* of 1852 are hasty and controversial; Sidgwick's *Outlines* (1886) gives only about 100 pp. to English ethics; and other 'outlines,' such as the sketch in Wundt's *Ethics*, are still more condensed. Dr. Albee's chapters discuss Cumberland (2), Shaftesbury and Hutcheson, Berkeley Gay and Brown, Hume, Hartley, Tucker (2), Paley and Bentham, John Mill (3), Herbert Spencer (3), and Henry Sidgwick (3). It is a pity that so good a book should not be better printed.

The Ethic of Freethought and other Essays and Addresses. By KARL PEARSON, F. R. S. Second edn., revised. London, A. and C. Black; New York, The Macmillan Co., 1901. pp. xiii, 431.

The Grammar of Science. By KARL PEARSON. Second edn., revised and enlarged, with 33 figures. London, A. and C. Black, 1900. pp. xvii, 548.

We are glad to call attention to these new editions of Professor Pearson's works. Neither of the books before us has undergone any substantial change, though both have been thoroughly revised by the author. The Grammar contains two additional chapters, dealing with fundamental conceptions in the field of biological science: ch. x, Evolution: Variation and Selection: ch. xi, Evolution: Reproduction and Inheritance. It need hardly be said that the works are standard in their respective fields.

Die wissenschaftlichen Grundlagen der Graphologie. By G. MEYER. Jena, G. Fischer, 1901. pp. 81, with 31 plates.

This work attempts to correlate handwriting and character, on the ground of three principles: those of involuntary motor tendencies, of the ideal copy (*Leitbild* or *Zielbild*), and of the parallelism of the activity of writing with the associative activity at large. The author makes full use of modern psychological literature, and does his best with a topic which is certainly not yet 'spruchreif.'

La psychologie du rêve, au point de vue médical. By N. VASCHIDE and H. PIERON. Paris, J. B. Baillière et Fils, 1902. pp. 96. Fr. 1.50.

The thesis of this little book is that the dream is a valuable source of information not only of our mental but also of our bodily condition, and should therefore take its place among diagnostic symptoms. Not only nervous pathology, but pathology in general (typhoid fever, intestinal, cardiac and pulmonary affections) may make good use of it. Special attention is given to the rôle of dreaming in the insane consciousness, and in hystericals and epileptics. The treatment is practical, and many records of cases are given.

Anleitung beim Studium des Baues der nervösen Centralorgane im gesunden und kranken Zustande. By HEINRICH OBERSTEINER. Vierte, vermehrte und umgearbeitete Auflage, mit 250 Abbildungen. Leipzig und Wien, F. Deuticke, 1901. pp. xvii, 680.

The first edition of this standard work was published in 1887, and within a few years it had been translated into English, French, Italian and Russian. In face of this general recognition, the reviewer's task is easy. We need only say that the present edition is thoroughly up-to-date, and that the author has in many places simplified and clarified his exposition.

Fragments of Philosophy and Science, being Collected Essays and Addresses. By J. M. BALDWIN. New York, Chas. Scribner's Sons, 1902. pp. xii, 389. Price $2.50 net.

In this volume Professor Baldwin has brought together articles, essays, reviews, etc., published by him in various magazines during the past fifteen years. "It is thought worth while to gather them together because—and the selections are made with view to this—they are related to larger topics on which I have published more extensively —or intend to—in separate works." There is no new matter in the text, but an attempt has been made to bring the book up to date by means of foot-note references.

Thomas Henry Huxley. By E. CLODD. New York, Dodd, Mead & Co., 1902. pp. xiii, 252. Price $1.00 net.

This is an accurate and very readable sketch of Huxley's life and work. It owes much to L. Huxley's *Life and Letters*, as any future biography must do; but the material has been recast by the writer in attractive literary form.

Kant's Prolegomena to Any Future Metaphysics. Edited in English by Paul Carus. The Open Court Publishing Co., Chicago, 1902. pp. 301.

Although this translation is practically new, the efforts of Mahaffy, Bernard, Richardson and Bax are considered. To it are appended a convenient chronology of Kant's life and publications, and an index.

Leibniz Discourse on Metaphysics, Correspondence with Arnauld and Monadology. Translated by George R. Montgomery. The Open Court Publishing Co., Chicago, 1902. pp. 272.

These three treatises of Leibniz give a convenient survey of his philosophy in its genesis and final form. The first was written when he was forty and was not published during his life, and the monadology appeared two years before his death. Only the monadology has never before been translated.

Outlines of Metaphysics, by JOHN S. MACKENZIE. Macmillan and Co., London, 1902. pp. 172. Price, $1.10.

This small book, dedicated to Edward Caird, deals well with a great subject. The genesis of experience and the criticism of ideal constructions of various kinds constitute the leading themes, under which the special topics are—the general nature of experience; method and theories of metaphysics; sensation, perception, thought; ethical, æsthetic, religious, and speculative constructions.

Boethius's Consolation of Philosophy. Translated by W. V. Cooper. (The Temple Classics.) J. M. Dent and Co., London, 1902. pp. 175.

This tasteful little book is the first attempt at a twentieth century version of this work, the first translation of which was made by Alfred the Great.

Die Wirkungen des heiligen Geistes, nach der populären Anschauung der apostolischen Zeit und der Lehre des Apostels Paulus, von HERMANN GUNKEL. Göttingen, 1899. pp. 109.

This monograph is an admirable work with characteristic German thoroughness and written with abundant references to the available literature upon the subject.

The Problem of Consciousness in its Biological Aspects, by CHARLES SEDGWICK MINOT. Reprinted from Science, July 4, 1902, Vol. 16, pp. 1-12.

The strict neurologists will, of course, refuse to follow the author in his chief lines of argument. Perhaps they will more strenuously object to the view that conscious actions are primary, and reflex and instinctive actions secondary. The germs of consciousness may very likely run down to the very lowest living organisms, but to prove that it is so commanding a factor in evolution, as the author assumes, is at present entirely impossible. In our humble opinion, our leading biologists like Whitman, Minot, and especially Brooks, who are becoming interested not only in psychological but in the epistemological theories, would render a better service for science by contributing to the comprehensive study of not only functions but the habits and life histories of animals which this author so well desires. If those to whom we look for the study of life are to divert themselves to formulating "dollish ideas" concerning the nature of consciousness—the most slippery and indefinite of all metaphysical conceptions—we are certainly in a bad way. If those who have spent their lives in tracing forms of microscopic tissues desire or need in fulfilment of some great law of human nature to enter a larger and more humanistic or psychic field, let them guide us psychologists in the study of the instincts of animals. If the current rage in certain philosophical quarters for analyzing ultimate reality—a passion now happily in a rapid stage of decline in the departments where it sprung—is to infect biologists, it will have another grievous sin to answer for.

Von der Nervenzelle und der Zelle im Allgemeinen, von PAUL KRONTHAL. G. Fischer, Jena, 1902. pp. 274.

The first part treats the biology of the nerve cell with chapters on staining and fixation and contains nine full page plates with description, on which the author bases his own interesting conclusions. The most important of these are that the leucocytes are the source from which the nucleus derives its chromatic substances; that the larger cells in the anterior horn of the cord as well as in the gray matter of the brain are found in very different conditions in healthy persons; nerve cells never divide even in the embryo; they decay and arise by the fusion with leucocytes anew.

The second part of the book treats of the cell in general and of nerve cell in particular. It is an elementary organism arising from formed and unformed materials and must contain nutritive matter which is unformed. The living substance in its relation to the cell; the difference between protoplasm and nucleus bioids; how the cell takes and works up matter; why it is not an organism or a cell at all in a biological sense; how the phenomena we see in the cell are the effects of outer forces, are treated, with final chapters on heredity and death.

Das Problem der Willensfreiheit in der neuesten deutschen Philosophie, von LEO MÜFFELMANN. J. A. Barth, Leipzig, 1902. pp. 115.

On the basis of a critical examination of the chief modern literature upon the question of freedom which itself gives this pamphlet great value, the author finds as a result of his analysis that the solution of the problem is simple and is determinism. A bibliography of the most recent literature upon the subject closes the volume.

Deuxième Congrès International de L'Hypnotisme Expérimental et Thérapeutique tenu à Paris du 12 au 18 Août 1900. Vigot Frères, Paris, 1902. pp. 320.

One of the most interesting articles here is Bérillon's history of experimentel hypnotism with photographs of Braid, Durand de Gros, Liébeault, Mesnet, Richet, Luys, Charcot, Paul Richer, Pitres, F. Raymond, Dumontpallier, Paul Magnin, Jules Voisin, and finally Bérillon himself with several views from his clinic. The important articles are by Vogt on the value of hypnotism as a means of psychological investigation; by Lemesle and others on hypnotism from a medico-legal point of view; Crocq on its relations to hysteria; and by Bérillon on its applications to pedagogy and mental orthopedics.

Kathlamet Texts, by FRANZ BOAS. Smithsonian Institution Bureau of American Ethnology, Bulletin 26. Govt. Print, Washington, 1901. pp. 261.

The texts in this volume were all told by one person, Charles Cultée, who is one of only three who speak the Kathlamet dialect. The text is given on the upper part of the page in coherent English; the original language is printed below with literal interlinear translations.

L'Année Philosophique (F. Pillon) 12th year, 1902. F. Alcan, Paris, 1902. pp. 312.

The leading articles in this volume are by Brochard on the work of Socrates; by Hamelin on the logic of the Stoics; by Robin on Aristotle's psychology; by Dauriac on the category of being; and by Pillon on Bayle's critique of Descartes's theism. The bibliography of French philosophy for 1901 covers pages 155-309.

NOTE.

On August 16 Professor Wundt celebrated his seventieth birthday. A *Festschrift* comprising some forty original articles by his former pupils was presented to him on this occasion by an international deputation, consisting of Professors E. Kraepelin, O. Kuelpe, A. Kirschmann, F. Angell, E. Meumann and Dr. W. Wirth. The *Festschrift* will be published as two extra volumes of the *Philosophische Studien*, each of about 750 pp.

THE AMERICAN

JOURNAL OF PSYCHOLOGY

Founded by G. STANLEY HALL in 1887.

Vol. XIII. OCTOBER, 1902. No. 4.

THE BIRD LOVER AS A SCIENTIST.

By O. G. LIBBY.

The extraordinary growth of interest in nature study in this country has had a marked effect not only on pedagogy and all related subjects but also upon biology and its allied sciences. The investigations of the zoölogists, especially, are being enriched by the labors of a large number of enthusiastic and wholly unrecognized amateurs. In the field of bird study there are many problems that escape the trained zoölogist, familiar only with prescribed routine of manual and laboratory. But the bird lover has at least one advantage over the scientist, he is in touch with the bird on the human side, he sees in this form of animal life the acme of the intellectual and the artistic combined. Where the biologist is scientific, the bird lover is sympathetic.

This gives the latter a considerable advantage, for, while he may acquire the requisite technical skill in order to study his favorite subject more scientifically and still keep his sympathetic touch unimpaired, the scientist can never reach this close relation by the road of the dissecting room and the microscope. It is then to the amateurs, and not to the scientists, as a class, that the teaching world owes much of the new impulse in the direction of bird study. For a student who lays aside his manual and attempts the difficult task of conducting a class in bird study out of doors with living forms for material, there comes a disagreeable surprise on finding out that, after all, our knowledge of birds is exceedingly limited and very inexact. Problem after problem will arise in actual observation for the solution of which there is little or no help to be found in the printed accounts. Take the single case of the color changes in the plumage of the bobolink, the scarlet tanager, the orchard oriole or the redstart. Has any observer yet been able to state just how the transformations take place, when and where? In the case of the orchard oriole and the scarlet tanager the changes extend through a period of nearly three years. One would suppose that if the scientists who study fish and reptiles could have the patience to count the scales for the different species, that some scientist would have undertaken the task of counting the feathers for the different species of birds. Yet if this were seriously proposed at a meeting of scientists, there is no doubt but that it would be laughed at. We may hope, sometime, to see the amateur, whose time is of no value, take pains to count the feathers on the different species of common birds and carefully tabulate them by the various feather tracts of the skin, making a separate study of the varying proportions of colored to uncolored feathers. The value of the results reached will then be recognized by the scientist and the study will be pushed to its logical outcome.

When this is done we shall know, as we cannot now, the effect of climate, food and locality upon a bird's feathers, both as to number and texture. This will, perhaps, supply the most effective means of determining whether our winter birds migrate and whether those we see here during January are from the north. In the problems of evolution, this feather counting would give a means of ascertaining exactly how far individual variation could proceed within the limits of the species and along what lines of feather development this variation proceeds.

Wallace has pointed out that among individuals of the same species of birds there is great diversity in the measurements. Following this suggestion the writer made a careful study of one species, the common red winged blackbird. Twenty-four measurements were taken for each bird and about sixty birds were measured. The accompanying plates indicate the range of the diversity, in twenty of the whole number measured. Eight sets of measurements were selected and the table below indicates the character of these measurements.

TABLE I.

I. Length of intestine.
II. Extent of wings from tip to tip.
III. Length of body from end of beak to tip of tail.
IV. Length of wing.
V. Length of esophagus.
VI. Length from clavicle at tip of breast-bone to the cleft of the lower mandible.
VII. Length of tail.
VIII. Length of head.

If these sets are compared it will be seen that no one bird exceeds in all but rather that each bird has some noticeable proportion of measurements which differentiates it from all others. In some the tail or wing, is longest, in others the body or head. Whatever the particular environment calls for in the evolution of new habits or characteristics is thus to be found in some of the individuals of a medium sized flock. The fittest that survive are the ones who possess among other things that peculiar proportion of measurements which adapts it to the new demands of food-getting or escape from enemies.

An excellent illustration of this partial evolution of a species from the habits and proportions of one family into another totally different is to be found in the warbler family. The black and white creeper has lost a large number of his original warbler characteristics and has taken on those of the woodpecker. This appears in the color, in the lengthened beak, the flattened body, and in the method of locomotion. A still better illustration is the Louisiana water thrush. This bird frequents the banks of streams, and gets its food after the fashion and in the same places as does the snipe. As a result the color is a fair imitation of that of the snipe, both above and below; the beak is longer and the body is larger than that of the average warbler and its habit of flying up to a low bush or overhanging limb when alarmed tells the nature of its enemies. But most characteristic of all, this warbler has the gait of the snipe, even to the tilting motion of the body. From a tiny brilliantly colored acrobat of the treetops there has evolved a plump sober-colored snipe-like creature whose markings and motions are all the results of the new environment.

The variation of proportions in the measurements shown in the plates may not indicate that evolution of other forms is still going on but it certainly points back to a time when species was more flexible and readily developed along whatever line seemed to offer the least resistance. But evidence of variation among individuals of a species may be found outside mere physical characteristics. One of the most enjoyable features in bird study is the song. In this almost wholly unworked field, where there is so much to discover, it has already been pointed out that the amount of individual variation in a given species is sometimes extraordinary. Such well known singers as the field sparrow, the American goldfinch, the song sparrow and the meadow lark furnish examples of this kind of variation.

Thirty-five songs for the field sparrow, and twenty for the song sparrow have been reported, and to any one at all familiar with the vocal performances of these birds, this will not seem at all unusual. White throated sparrows show surprising individual variation in their rather long and characteristic song.

The Baltimore oriole is still another singer of great capabilities and wide range of variation. Indeed the oriole seems to me to make the nearest approach of any of our birds to the sounds in human speech. On the occasion of a wheel trip from Wisconsin to the northeastern portion of Ohio the writer was struck by the local variation in bird songs. The vesper sparrow, for instance, in Ohio, began his song with the two notes of the chickadee's song. The swamp blackbirds were noticeably different, also, and so were the meadow-larks. There is no doubt an opportunity here for some amateur who has the musical training to discover and make use of what has so long lain unknown and unused.

Another interesting question arises in connection with the time when young birds learn to sing. The period of song varies so much with different species that no fixed rule seems to prevail. It is sometimes possible, also, by observing the singers in a given species to ascertain how long it takes for the young males to assume the full male plumage. One illustration will suffice;—a purple finch in female plumage was found singing the full spring song, which would seem to indicate that it takes two years for the species to assume the male plumage. Songs and calls are the language of birds, and by this means all the emotions find expression and thought is conveyed. In the works of Thompson-Seton the language of animals is very cleverly used in a series of charming sketches, and though the author too often calls upon his imagination to eke out his facts, yet there is a sufficiently substantial basis to his tales to make them excellent interpretations of nature. Some years ago the writer assisted on the relief work in a city which had been devastated by a cyclone. The most painful experience that remained after two weeks' work among the horrible debris of the ruined homes was to hear for several mornings at daybreak the pitiful song of a Baltimore oriole whose nest, eggs and dead mate were picked up near the house. Since that time the motif of this song has been identified with a very effective strain in a funeral march written by Grieg.

The most marvellous phenomenon in bird life beyond all question is the semi-annual migration. The numbers of the birds, the distance travelled and the dangers and difficulties to be encountered all contribute to make this a notable performance. But, in spite of its importance, bird migration has received comparatively little attention in America. There are three ways in which this movement may be studied. First we may keep note of all arrivals and departures day by day and thus ascertain dates for successive years. If there are observers enough to cover a given region fairly well, a good summary of the whole movement may be worked out. This for the most part is the only method by which migration has so far been studied. Some reports have been made relative to the destruction of birds at lighthouses, but no one has yet studied migration at these danger points with a view of recording the exact number of species and individuals for every month in the year. From some acquaintance with lighthouse keepers it seems certain that if the government would supply these men with such a manual as Chapman's, many valuable records could be kept by them. Certainly the lighthouse keeper is the most natural observer to be selected to keep account of the loss of life at his station and most of them would do this willingly if they knew it would be of service to any one. Such monuments as the one at Bunker Hill and the Washington monument frequently attract migrating birds in cloudy or foggy weather, small flocks of such birds may often be heard calling about the tops of these structures. Along the Appalachian mountain mass the coke ovens that burn all night also prove attractive to migrants. These ovens throw a broad band of light upwards to the clouds. When the migrating birds reach this light they turn downward and are often found fluttering about the fires by the watchmen there. Those observers who have access to such places as these should preserve a record of those birds that have been deflected from their course by delusive lights.

A second method of observing migration lays emphasis upon the calls of the passing birds, their number, direction and character.

In the fall of 1894 my attention was attracted by the calls of a certain species of birds passing overhead during several nights in middle September. There was an unmistakable family resemblance in these calls as the migrating birds came trooping out from the north, making the spaces of the upper air ring with their mellow calls. Now and then this merry chorus would contain a discordant note of a bird of another species showing that other birds were mingled in the great swarm headed southward. This particular flight continued for three nights, all cloudy and very dark. The line of flight seemed to extend to the westward and to lose itself in the distance.

While such observations appeal to the scientist they have meanings also to the bird lover. There is something weird in these high-pitched calls sounding down out of the upper darkness. They seem to express by turns, fear, doubt, hope or confidence. Sometimes the call is complex and like that of the young rose-breasted grosbeak expresses the first bewilderment of the fledgling, thrust out into unfamiliar surroundings and winging his way amid utter darkness, guided only by the cries of his fellows. But besides the charming naïvete of the mellow call of this grosbeak, it seems to express also, that light-hearted optimism which sustains the whole bird family during the trials and dangers of their semi-annual flight. One could wish for that knowledge of the language of animals in which Mowgli of the Jungle Stories is so well versed and which Aaron of the Wildwoods teaches to Buster John and Sweetest Susan. With such a gift of understanding, the favored mortal seated beneath the hurrying stream of migrating birds far above him, could translate the myriad sounds into messages marvellous and unique, full of strange adventure and hair-breadth escape, telling of far-away lands and myriads of well-hid nests, of life on the water along solitary beaches or amid the unbroken stillness of the vast pine forest; messages redolent with perfume of tropical flower jungles, glowing with the fresh eager life of a new spring, overflowing with delight at the long flights over ocean, mountain and wide-spreading plain. Yet this wonderfully tangled mesh of sound that descends upon us out of the sky does not hold us spellbound and mute till the marvel has passed by; it comes to the busy and indifferent multitude unheeded. Every year over the crowded streets of busy cities float these feathered multitudes, but their loud cries of wonder and fear as they descry the lights below them find few listeners in the hurrying throng. We are so immersed in our bustling existence that the very messages from heaven make no impression upon us. Birds are especially noisy on foggy or rainy nights. On several occasions during the May migration at Madison have severe thunderstorms caught a large flock of migrants and sent them scurrying down by hundreds all over the city. The piteous cries of these wet and bewildered birds heard amid all the noises of the storm sufficiently express to a sympathetic listener their utterly disconsolate condition. One might almost imagine them to be a train load of drowsy but indignant travellers spilled out of their comfortable places by an accident and seeking by devious and unpleasant ways the dubious hospitality of a near-by village.

A detailed observation of the calls of birds during the night was made Sept. 14, 1896, at Madison on a small elevation southwest of the city. The sky was clear, there was no moon, and a raw southeast wind was blowing. The total number of calls counted between ten and three o'clock was about thirty-eight hundred, or an average of twelve per minute. As in 1894, the mass of sound seemed to lie toward the west, which would make the general direction of flight from northeast toward the southwest. Though the observation extended from ten till a little past three the calls began much earlier in the evening and kept up long after four. A great variety of birds passed overhead during this evening and in all sorts of groups or flocks. Sometimes the lines of birds would seem to extend for more than a mile in perfect formation, as indicated by the regular calls up and down the whole line. At other times smaller squads of more swiftly flying birds would dash by overhead keeping up the compact formation with the precision of trained cavalry.

This method of observing bird migration is not difficult and it has the great advantage of being open to every one. The best time to observe is in May and September, and cloudy or foggy nights yield the best results. It is possible, nevertheless, to hear the calls of passing birds as early as the latter part of August and they do not cease even into November. As late as Thanksgiving, in the latitude of St. Paul, Minn., a large number of calls were recorded between nine o'clock and midnight. Regular observations covering a month each year, even if limited to a single hour in the night, would soon come to have a great scientific value. In a subject so little studied, every one is a discoverer and all observations are of value if made with care.

One valuable conclusion was reached by this study of nocturnal flight. It has been repeatedly alleged that captive birds are attacked in the spring and fall by fits of restlessness, which lead them to beat their wings against their cages in vain endeavors to escape. This has been adduced by careless observers as a proof of the migratory instinct. But like most of the facts upon which the hypothesis of instinct rests, this one has been misinterpreted. The captive bird hears the calls of his own species during their semi-annual flights and very naturally tries to escape to join them. The duller human hearing of his captors entirely misses the sounds which to him are full of meaning, and his efforts are considered as proving the existence of a blind impulse termed instinct.

A third method of studying migration consists in observing the birds as they pass across the face of the moon. In this method a small telescope is necessary or a good surveyor's instrument. In this way it is very easy to take leisurely observations of a very wonderful phenomenon. The birds are visible on the disc of light from one-tenth to one-third of a second for the rapid flyers and for the slower ones they are sometimes visible two or three seconds. The first record made was during the nights of September 11, 12 and 13, 1897. The telescope used belonged to the Washburn Observatory and was a small six-inch instrument. A total of five hundred and eighty-three birds were counted in the three evenings which, it was estimated by Prof. A. S. Flint, represented 168,000 birds passing Madison within range of the telescope. This will give some faint idea of the nature of the movement a portion of which passes under one's eye in so short a space of time. The first conclusion reached by these observations was that the bulk of the birds used but a small portion of the night for flight. Plate III shows graphically at what hour most of the birds are on the wing. The apex of the movement is seen to be attained at 10.30, and in less than an hour later the flight has largely passed. That the record shows birds flying as late as five in the morning indicates, as we should expect, that the different species fly for different lengths of time, the strong-winged birds keeping up their flight much later than those weak flyers. It is also to be noted from the chart that the birds move in waves, passing successively over a given region. This is in harmony with observations taken by every other method and is indeed one of the better known facts about bird migration. It was further observed that the birds did not all take one direction, but it was not until several years later that other records were placed with these and a satisfactory conclusion reached. From plate IV is seen indicated the direction of flight for each bird across the moon's face; the more heavily shaded portion of the line being that portion of the field at which the bird passed out of sight. If the predominant direction of flight for August and September be compared it will be noticed that they are at right angles to each other, and it will be seen further, from the principal directions of flight in the spring, that the flight in May corresponds in direction to that in September while that in April corresponds to that in August. Whatever astronomical errors may have been made in reducing the directions across the moon to earth directions, it still remains a fact that in the spring and fall there are two well defined lines of flight at right angles to each other and that the later one in the spring corresponds to the one in September. Different directions in flight mean different routes, and this would seem to indicate different species of birds and to suggest a variety of routes to correspond with the great differences in point of wing-power, food, enemies and intelligence among the large number of species that migrate. The migration thus becomes an immensely complicated process having all possibilities for individual or species variation which is afforded by any other of the vital activities in bird life. A further study of the figures in the plate will show that in each of the months there is evidence of birds of another month. For instance, in the figure showing directions of flight for May will also be seen a considerable number of lines having the direction which was found to be the predominant one in April, and this will be found true in every one of the figures in the plate. In other words the May birds begin their flight in their own direction as early as April. We know this is true from other observation; the myrtle warbler comes early, while the bulk of the warblers come in the middle of May. But still another conclusion may be drawn from the material shown in these figures. While the great majority of the birds followed one general direction there were a considerable number of scattering flights recorded. These undoubtedly represent lost birds who are wandering in every direction seeking their missing comrades. The dotted lines in the figures represent the track of lost birds who changed their course within range of observation. In every case it will be noticed that the dotted line points along some general route as it leaves the circle, indicating that this records the flight of a bird that had wandered away from the flock and was just rejoining his companions or those of his own species.

This evidence of wandering on the part of migrating birds even when there is a full moon serves as a striking proof that it is no mere impulse that drives birds on the long semi-annual journeys. We have seen that birds do wander in cloudy or foggy weather, especially during storms. But here is visual proof that a certain number of them wander out of their course in a great variety of directions. What then becomes of the hypothesis of an unvarying instinct that guides the birds as gravitation holds the stars in their courses? For this theory to be true there ought to be no wandering or lost birds either on clear or cloudy nights. That there are such birds continually present, the records of every observation for the past five years abundantly prove. Only a beginning has been made in the study of the nocturnal flight of birds but it is a subject that promises well for the amateur and will yield the scientist a rich return as soon as he can be convinced it is worth his while.

For the present a few observers are doing the work for the mere pleasure of it. None of those who aided in gathering the material presented in this paper could restrain their exclamations of delight or astonishment as the birds floated leisurely into sight or dashed pell mell across the little circle of light. There was constant evidence of the highest activity and steady purpose in the perpetual come and go of the moving birds, and upon turning the eyes away from this busy scene to the quiet moonlit landscape as it lay in midnight hush outside, the contrast was striking in the extreme. Those who participated in the labor of observation all felt that what had so long remained securely hidden from us, had at last yielded itself to cross-section study of the most approved scientific type. But it was no less a peep into fairy land as well, to watch the tiny hurrying forms flit silently across the charmed circle that rendered them visible to mortal gaze.

The rate at which the birds moved was very much affected by the wind. Numbers were recorded as seeming to be blown along with hardly an effort, while others sailed, occasionally flapping their wings and apparently borne on by a strong current of air. One bird was noted in particular since it passed slowly *backward* across the moon, evidently too tired to struggle longer against the wind. The identification of the birds seen was not possible in most cases. Gulls and swans were observed at different times as were also ducks and geese. There were identified a large number of swamp blackbirds, some meadowlarks, a night heron, some robins, a night-hawk and a sparrow-hawk. A number of very small birds were recorded as passing "like a shot" and were probably either swifts or swallows. It is claimed that many strong-winged species of birds migrate only by day, but as most of these have been observed through the telescope at night, this theory, also, must yield to the recorded fact.

In view of the continual presence of such birds as gulls, ducks and geese at night, migrating with the rest, their migration by day seems a little hypothetical. While it is true such birds move about a good deal during the day in search of food, there has never been a set of observations in this country which has proved day flight as persistent as it has been demonstrated to be during the night. Nocturnal migration seems to prevail throughout the bird world and for the best of reasons. As the birds move out of their accustomed haunts into new regions, food-getting becomes a serious problem especially since the motive power of flight must be supplied by such food as can be found in a strange land among unknown dangers. Daylight alone would render such search for food safe and certain for the hungry birds whose long flight the previous evening had left exhausted and in great need of refreshment. Night time is better for migration in large flocks since the danger of attacks from hawks and shrikes is greatly lessened. That they see the general configuration of the country is certain, and the stars and moon also guides them as well. Foggy nights, while not interfering at all with a hypothetically perfect instinct of direction, do make it hard for birds to find their way since they have not the infallible guide which it is fabled that they possess. Great physical features like river valleys, mountain ranges and coast lines are the guide lines of bird migration, and at their distance above the earth, the whole lies in perfect panorama beneath them as they fly. In this country the fly lines for our birds are the Atlantic coast lines, the Appalachian Mountain mass, the Mississippi River, the Great Lakes, the Rocky Mountain and coast ranges and the Pacific coast. Particular points along these lines are specially dangerous to migrants. The lighthouse at Key West, in Florida, stands at a place where all the birds from Maine to Georgia pass by as well as those that inhabit the higher regions of the Appalachians. After severe storms at this lighthouse thousands of dead birds lie piled at the base of the tower. Another danger is the lighthouse at Mackinaw Strait between Lake Michigan and Lake Huron. Here are concentrated all the lines of flight from the upper shores of the lakes and from all the interior waters of Canada.

It would render the lighthouses much less dangerous to migrating birds if the lights were changed from the fixed to the alternating form. The keepers at Minot Ledge say that when this lighthouse had a fixed light a large number of the birds flying from Cape Ann to Cape Cod or the reverse were blown inshore and dashed against the tower by the strong northeast gales. Now that the light is an alternating one, the birds are able to avoid it when they are driven in by a storm and so escape death. Another fruitful source of disaster to migrating birds is the old-fashioned electric tower or mast which places a light or a group of them high in the air above the city. For lighting purposes they are quite useless but they will remain a menace to birds till they finally give way to more modern and less expensive modes of lighting.

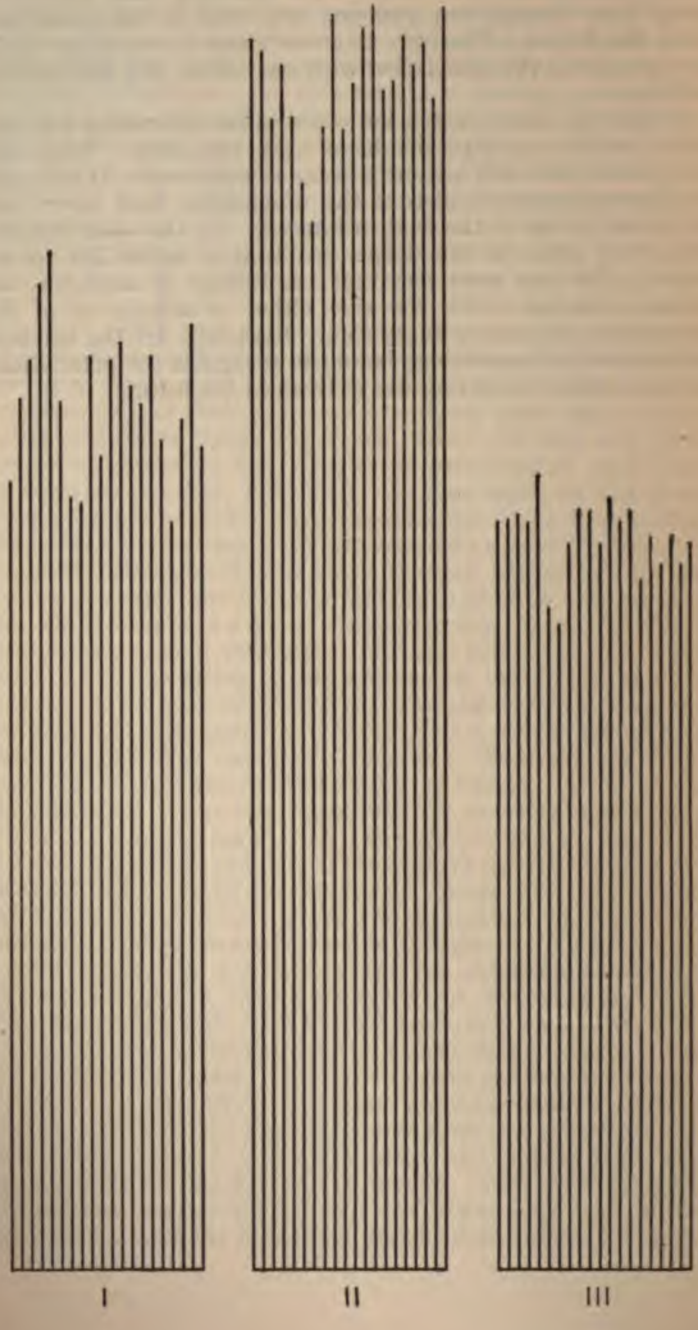
Observation of nocturnal migration in the manner described, and records of the number and kind of birds killed at coke ovens, tall monuments, lighthouses, and electric towers will in time form a body of material of the utmost value to the student of bird life. Such facts are worth numberless theories and will help to dissipate much of the pseudo-scientific half-truth which is so prevalent in the popular works and hurriedly prepared manuals. We are just coming to realize how extremely ignorant the best informed are on so fundamental a question as migration. Until the omnipresent scientist occupies this field and drives out the amateurs, there is unlimited opportunity for discoveries of the highest importance; a golden harvest to be reaped by the unpaid enthusiast.

In the economy of bird life, migration plays an extremely important part. As a factor in the evolution of a perfect bird, one best adapted to its environment, migration must ever be considered as holding a high place. No weakling can survive the tremendous strain of the long journey southward from the nesting places into countries all unknown to the thousands of young birds. The stragglers drop out by the way or are picked up by the attendant hawks and shrikes that skirt the flanks and harrass the rear of the bird armies, and by spring-time it is the pick and flower of the year's product that find their way safely northward to select the choicest spots and rear their young for the next trial trip. Survival of the fittest has a meaning in this supreme test of wing power and lung capacity, of courage and prudence and indomitable perseverance. Again, migration serves to scatter and redistribute the various groups of individuals. In this way new feeding grounds are discovered and different species are more widely extended or take possession of more suitable breeding places. This process goes on so thoroughly that in spite of a considerable return of individuals to the same spot year after year, a pretty complete rearrangement of the bird population from the spring and fall migrations certainly takes place. In ten years' observation no year has been quite like any other either in the number of individuals in a given species or in the variety of the species observed. Each year seemed to be distinctive and marked off from all others, and the more complete the record the clearer was the evidence upon this point. An artesian well, sunk in a treeless Dakota prairie, poured its surplus water into a neighboring depression, producing a small lake. It was not three months old before the migrating birds discovered it and made it a stopping place on their way. As time went on and grass and shrubs grew thickly along its edge, the birds took possession of it and it became a populous oasis in a desert. Tall trees and thick undergrowth now mark the spot where the lake lies and it has become the home of hundreds of birds of many species, while from it as a center birds disperse in all directions during the season of migration. If the source of the water should fail the peopling of this spot would cease and the birds would soon learn to avoid the place where water and vegetation were fast disappearing. This is but a single instance of hundreds of similar cases, but it serves to illustrate one of the functions of migration in the economy of nature. In brief it is this that gives to our bird population the extreme of flexibility by which it adapts itself with the utmost ease to the great changes wrought in the face of the country during the past few hundred years. Of all the agents of change and destruction man has been the chief. Since his occupation of America a number of birds have made notable changes in their habits and so have become in a certain sense the companions of man.

The cliff swallows have abandoned the overhanging rocks where they built their flask-shaped nests, and under the eaves of barns they now build shallow saucer-shaped nests, where food is more abundant. The robins and phœbes have taken to living in nests often supported on man-made structures. Even the night-hawks rear their young on the gravel-covered roofs of the Chicago "sky scrapers" and gather their food above the smoke and dust of her streets. The chipping sparrow has now become the *hairbird*, and for a large part of her nest material uses the horse hair which she obtains by means of her association with man. The warbling vireo and wood pewee have become our common city birds in the parks and along the drives. The only common name of one of our birds has come from the association with our cattle, the well-known cowbird.

In this very brief sketch but a few of the interesting and unsolved problems of bird life have been indicated. There are many more that will instantly occur to every one. It is a matter of encouragement, also, to the unscientific bird lover that he has still most of the field to himself. In this most fascinating study some of the deeper problems of animal life are involved. No one need feel that the subject is unworthy his serious attention. On the side either of science or of the humanities, it is exceedingly rich. Especially are the teachers and students of psychology bound to recognize the possibilities here and make increasing use of them in the future.

PLATE I.



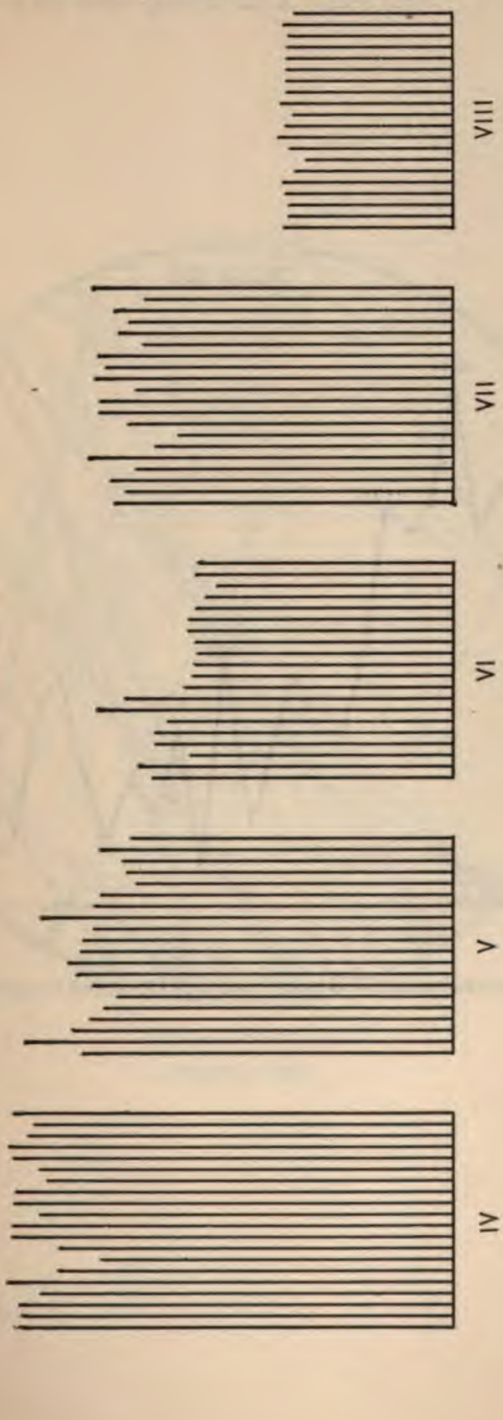
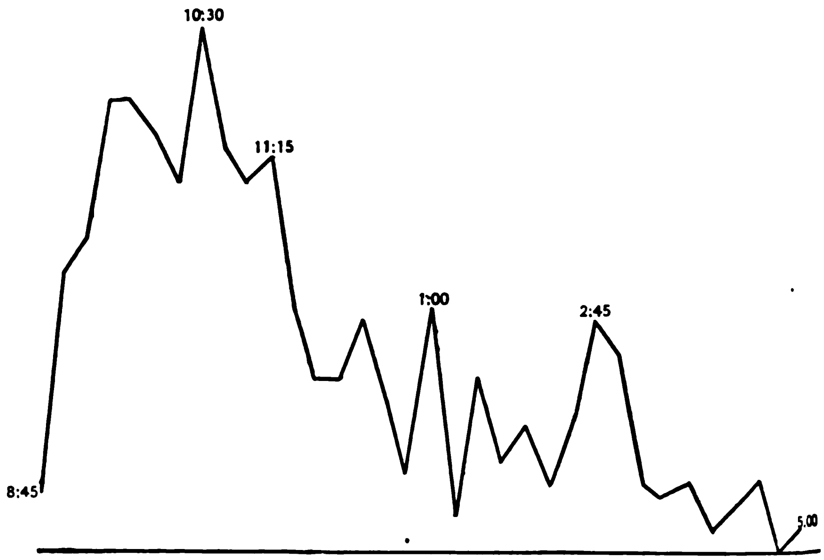


PLATE II.

PLATE III.



Graphic Representation of Number of Birds Observed by 15-Minute Periods.

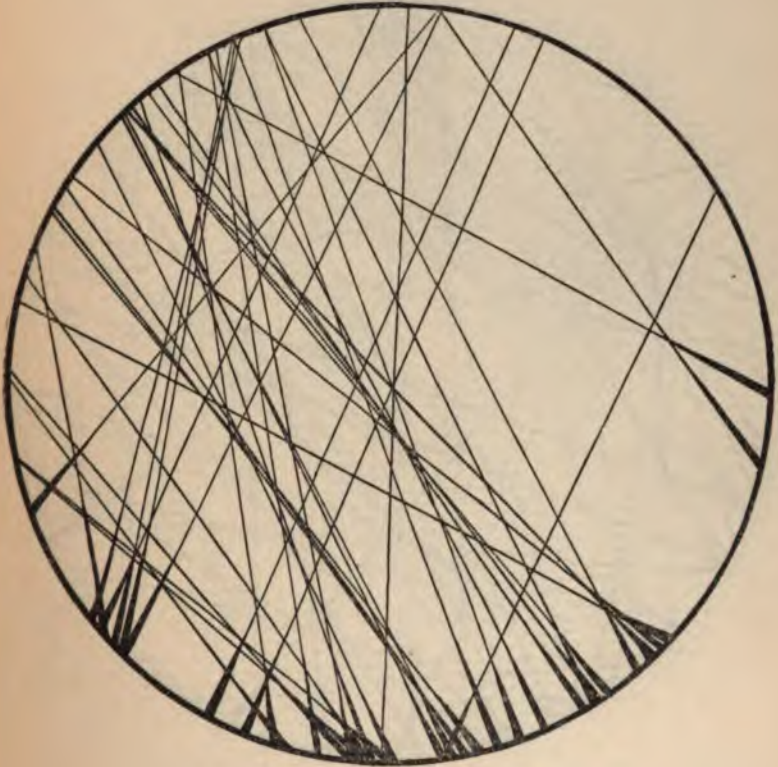


PLATE IV, No. I.
August, 1898.

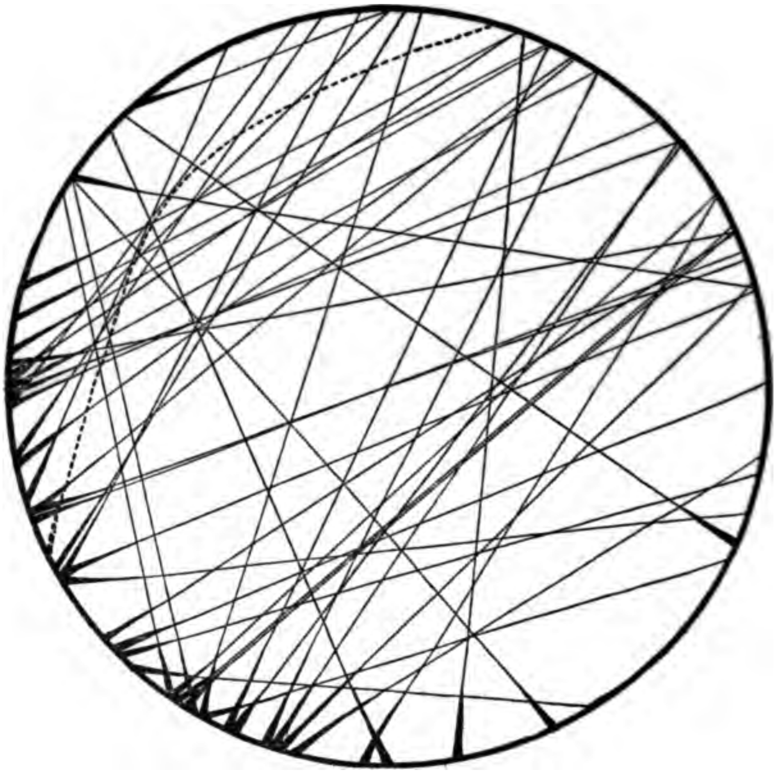


PLATE IV, No. 2.
September, 1899.

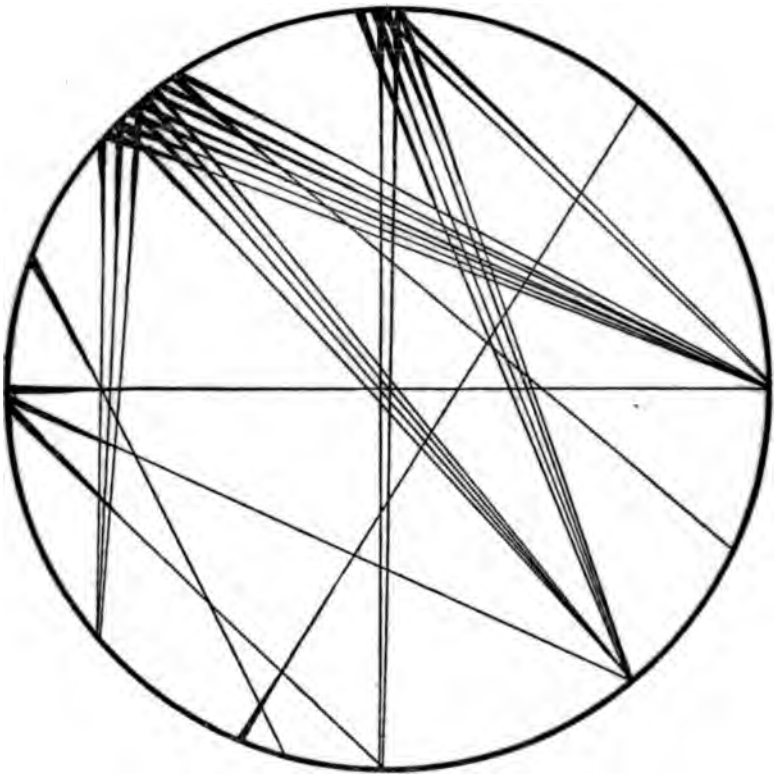


PLATE IV, NO. 3.
April, 1899.

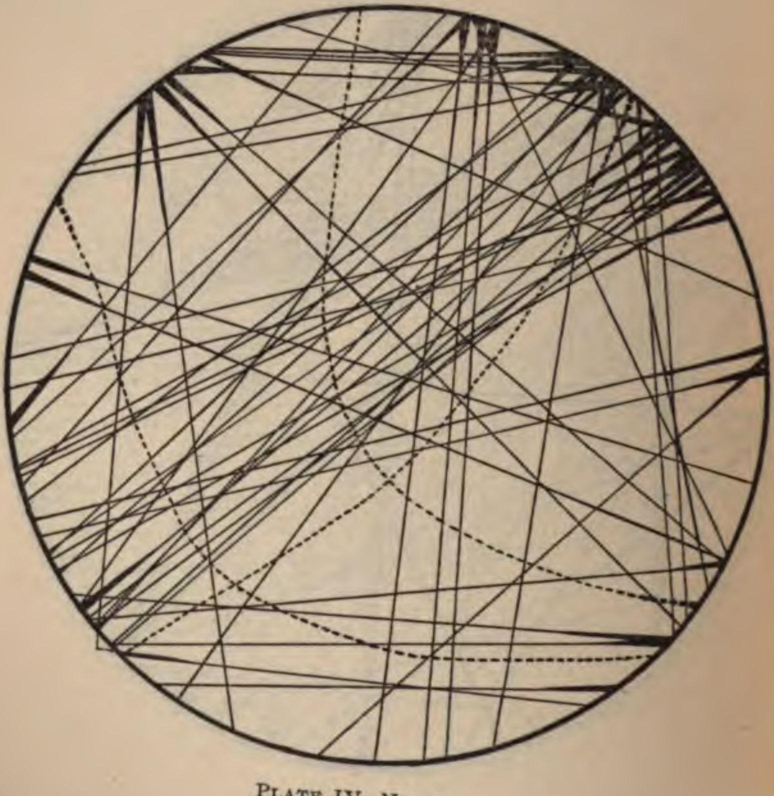


PLATE IV, NO. 4.
May, 1899.

MINOR INVESTIGATIONS IN SENSE PERCEPTION.

By Robert MacDougall, New York University.

I. On Determinations of the Subjective Horizon by Motor Co-ordination.

In the first volume of Harvard Psychological Studies which has recently appeared (Monograph Supplement 17, Psychological Review), an investigation concerning the subjective determination of the primary point of regard is reported by the present writer. In connection with that series of experiments an examination was made of manual and oculomotor co-ordination in such processes of spatial orientation. The relation of these factors in certain phenomena is well known. If the lateral axis of the head or the primary sighting-line of the eyes be not horizontal, the relations of the fundamental planes of space will be subject to distortion when these are determined by motor co-ordination of the hands. More specifically, if the head be tipped backward or forward, to one side or the other, the determination of horizontal lines in the plane of displacement will be negatively rotated. When the head is tipped toward the right, if one attempt to hold a bar in the two hands horizontally before the body and parallel with its lateral axis, the left end will unconsciously be depressed; if the tipping be toward the left, the right end of the bar will be depressed. These results are independent of the relation of the horizontal plane in which the line in question lies to that of the observer's eyes.

The problem to be determined in the experiments reported in the Harvard Psychological Studies concerned the factors of visual space orientation of this form under normal conditions, and the influence of unusual strains, positions of the body, and relations of external objects upon such determinations. Judgment was found to be affected by all of these, the movements and tensions of the eye-balls having the greatest influence. In connection with this investigation it became of interest to ascertain the relation of the subjective horizon of the eyes as determined by raising the index finger, to its position when determined visually, and the influence upon such location of changes in the orientation of the head and eyes.

The experimental arrangements of the previous investigation were maintained. Determinations of the horizon plane were made by the right index-finger in frontal and lateral vertical planes, the eyes being closed during the experiments, and the arm brought to a resting position in the lap between successive trials. The following experimental variations were to be tested. For determinations in both frontal and lateral planes, the position of the head being normal (a) locations with the eyes in their primary position; (b) locations with the line of sight elevated to the limit of unstrained adjustment; (c) locations with the line of sight similarly depressed. For determinations in the frontal plane alone—(a) locations with the head tipped upward and back; (b) locations with the head tipped forward and down. For determinations in the lateral plane alone:—(a) locations with the head tipped toward the right; (b) locations with the head tipped toward the left. Ten observers took part in the experiment. The individual averages of these were based upon series of fifty judgments each. The magnitudes of the angles of elevation and depression are given in degrees and fractions.

The results may be briefly summed. The plane of the subjective horizon under normal relations of body position is negatively rotated through a much greater angle than in visual determinations. The downward displacement increases from —7′.70 in locations made by the eye in a lighted room to —48′.9 in those made by manual co-ordination. It was found in the previous investigation that when the determination of the subjective horizon was made with closed eyes the line of sight was elevated to a point above the gravity horizon, the characteristic error being + 23′.69. The discrepancy between eye and hand is therefore to be reckoned thus much greater than the value of the absolute displacement, (48′.90 + 23′.69, or — 72′.59). The reason for this large error is to be sought in the normal co-ordination of these organs in the indication of positions in space. In pointing to any object the index-finger is habitually directed to a point below its actual location, in order that the line of vision may be left unobstructed. The free determination of the subjective horizon has thus reinstated the ordinary relations of eye and hand involved in simultaneous looking and pointing toward objects in that plane, and the characteristic error of location is therefore due finally to the anatomical relations of these two bodily members.

Determinations made with the line of sight of the closed eyes elevated (Experimental variation, I, b).) are marked by a negative displacement of large magnitude, the location now being,— 204′.40. The depression of the line of sight, on the other hand; (Exper. var., I, c).) is followed by no appreciable displacement, the absolute location of the horizon, namely,—49′.90, practically coinciding with that made under normal relations of the head. The difference in the results of these two forms of head rotation indicates apparently the significance of sensations of eye-movement and strain upon the process of localization. The degree of rotation in a bodily member is judged by the sensations of strain which develop in the course of its translation. As the curve of intensity in such experiences of strain exhibits a progressive acceleration with successive increments of angular movement, there arises the possibility of illusions of position and errors of estimation. In the present case the upward rotation of the eyes in their sockets develops a relatively intense strain experience, while in rotations of equal magnitude downward from the primary position of the eyes these muscular tensions are practically lacking. This difference arises from the biological relations of the organism to its environment, which call forth constant exploring movements of the eyes within the lower half of the field of vision, while very few are made above the horizon in the expanse of the sky. As a result of this discrepancy in the increment of strain, the over-estimation of the amount of rotation and consequent exaggeration of the corrective adjustment which appear in the one case are wholly absent in the other.

Results attributable to the same biological conditions appear when the whole head is rotated upward or downward. Upon the former movement follows a negative displacement of—146′.50; upon the latter, a displacement of—239′.40. When the chin is tilted upward, as was pointed out in the previous investigation, a reflex negative rotation of the line of sight takes place, which is practically lacking when the chin is dropped; the eyes move with the head in the latter case, while in the former they move independently of it and in the opposite direction. This downward rotation of the eyes does not involve noticeable sensations of strain; there exist, therefore, only the positive tensions of the supporting muscles of the head as factors of possible error in the first case, the effects of which appear in the negative displacement of the imaginary horizon. When the chin is depressed both systems of strain are reduced and there appears therefore a return to the normal co-ordination of hand and eye with a resultant large depression of the manually determined horizon, dependent upon the depression of the line of sight.

In all these cases the variability of the judgment is greatly increased over that of visual determination, the values of the mean variation being for rotations of the eyes:—normal, 55′.37; upward, 58′.80; downward, 56′.2; and for the head:—upward, 79′.80; downward, 60′.10. Every abnormality of position also reduces the accuracy with which the judgment is reproduced. Of the two forms of bodily displacement compared in the present investigation the upward rotation of both eyes and head is marked by greater interference with the normal processes of judgment than movements in the opposite direction. This relation appeared also in visual determination of the horizon, and is to be looked for as a consequence of the different parts which these two forms of movement play in ordinary perception.

The attempt to bring the index finger to the level of the eyes and at arm's length from the side of the body results in the location of a point far below their true position, namely,—332′.80. Both negative and positive displacements of the line of sight in the closed eyes during the process of locating these points in the supposed horizontal plane of the eyes are followed by characteristic errors, a phenomenon which does not appear in the results of experiments on the determination of objective planes under like circumstances. Rotation of the head in its frontal or lateral plane does not affect the process of adjusting horizontally a bar which intersects that plane at right angles. In the present instance the upward rotation of the eyes gives a displacement of—380′.1, or—47′.3 from the normal; their downward rotation gives a displacement of—300′.8, or + 32.0 from the normal. The direction of the error in both these cases is identical with the negative rotation of the subjective horizon which has been observed by other investigators to take place when the head is tipped in line with the points determined in that plane. As in the preceding experiments the greater correction accompanies upward, the less downward, rotation. The very large negative error which appears in these latter determinations is the result of the higher degree of muscular strain involved in bringing the arm up to the horizontal plane of the eyes at the side of the body as compared with frontal movements, and is not to be referred to any of the factors which are of interest in the present discussion. This error was not at all suspected by the reactors, and to the unforced character of the movements, with probably the additional factor of practice, is to be attributed the low index of variability which this series presents. The values are as follows:—normal, 46′.7; upward rotation, 53′.9; downward rotation, 49′.1. As before, the mean variation is greater in the case of upward than in that of downward rotation.

The last group of experiments, in which the head was rotated laterally, was not completed, and the results cannot therefore be given quantitatively. Enough was seen, however, of the influence of these experimental variations to show that their effects were to produce the characteristic errors of location which appear when the attempt is made to hold a bar in a horizontal position under similar abnormal bodily positions.

The conclusions to which these experiments lead may be summed up briefly. These forms of spatial orientation are related to oculo-motor conditions, and the direction of the characteristic errors which they present are dependent upon the co-ordination of eye and hand in the perception reactions of ordinary practical life. The variations in amount of this constant error are related to simultaneous changes of direction and amount occurring in the tension of the oculo-motor mechanism, specific errors regularly taking the form of displacements of a sign negative to the direction of rotation in the eye-ball. The variability of the process of determination is a function of the intensity of strain which characterizes the primary movements of the head and eyes, and is therefore dependent upon the degree of interference with normal conditions of functioning which the latter involve. The characteristic errors appear to depend upon the objective displacement of the point of regard, interpreted on the basis of the organic strains involved in the various types of rotation, rather than upon the internal relations of these displacements to the principal planes of the body. since the location of the subjective horizon is equally affected by rotations in either of two planes at right angles to each other. With these determinants combine certain constant factors of resident strain in the organ, to give specific form to the judgment, but the consideration of these elements does not belong to the present discussion.

II. THE RELATION OF SATURATION IN HOMOGENEOUS COLORS TO THE AREA OVER WHICH THE COLOR IS SPREAD.

The apparent intensity of a stimulus, it has been noted in the case of various sensations, depends upon the magnitude of the area to which it is applied. When the whole hand is plunged into warm water, for instance, it feels hotter than when only the tip of the finger is immersed. If the taste of a substance in solution be too weak to produce any sensation of taste when only a small portion of the tongue is stimulated, its flavor may become clearly discriminable when a larger quantity is taken into the mouth. This reinforcement of the intensity of sensation by increasing the number of sensitive elements affected becomes our common practical method in the discrimination of faint odors.

It is a natural inference from the connection which is found in these instances that the number of elements of the sensitive surface stimulated and the intensity of the resulting sensation stand always in such a relation of functional dependence that the subjective estimation of the intensity of a sensorial stimulus cannot be considered apart from the magnitude of the area excited.

In the case of certain senses it has been noted further that this summation effect is independent of continuity in the surface to which the stimulus is applied; intensive reinforcement takes place when the sensitive elements affected are not contiguous but form a discrete series. Thus in color vision if homogeneous light be distributed in the form of isolated spots of color the presentation of a sufficient group of these will give rise to a perception of their characteristic quality though the area of each individual unit be below the threshold of discriminability.

The small experiments reported in this paper concern two points in this general field; first, the quantitative relation of intensity to the number of elements stimulated in visual sensations arising from stimuli spread over continuous extents; and second, the quantitative relation of the stimulation area to the color threshold in continuous and discrete extents.

In studying the relation of saturation or color intensity to the area over which the color is spread three areas were compared, a unit of one square centimeter and two variables of four and sixteen square centimeters respectively. The series of six so-called pure saturated colors of the Bradley papers was employed. A double spindled color mixer was used, upon one shaft of which was mounted an unbroken disc of color, while upon that adjacent to it was mounted a combination of discs, including black and white as well as the color to be observed. In front of the revolving discs and just clear of their surfaces was stretched a screen of neutral gray paper, in which, near by each other, were cut two apertures having the areas of the unit and of the variable to be compared with it, respectively. Experiments were performed in indirect sunlight, the illumination coming from a point directly in front of the screen. The observer sat at a distance of one metre from the disc. Determination was made by immediate comparison of the saturation of the adjacent color areas, the record being made in terms of the angular magnitude of the color sector in the variable area, that of the unit being in all cases 360°. The work was obviously slow, since it was necessary to adjust the relative amounts of white and black in the neutral light introduced as well as the proportion of colored and uncolored light, in order that uniform brightnesses might be maintained between unit and variable areas. Two observers took part in the experiment; as the results in the two cases were parallel, only their averages will be given.

The proportions of colored light for each of the color qualities involved for the several areas are as follows:

	1 sq. c.	4 sq. c.	16 sq. c.
Red,–	360	342	318
Orange,–	"	295	270
Yellow,–	"	320	271
Green,–	"	282	261
Blue,–	"	341	324
Violet,–	"	298	240

The functional relation of the two factors appears in each of the two progressive variations introduced, and is exhibited by all members of the group of colors tested. In order to equalize the apparent saturation of two differing color-areas that of the larger must be reduced by the addition of a greater or less amount of uncolored light, varying according to quality and to the difference in magnitude of the areas. With progressive increase in the area of the colored surface the degree of apparent saturation likewise mounts. To what range of extents this relation applies, the present experiments do not show, since the greatest area included was still relatively small. The facts point toward the inclusion of all areas up to the limits of the total field of vision as thus affecting by their magnitude the saturation which the color presents; in other words a visual field all red or green is more vividly red or green than is any portion of that field seen amid neutral surroundings.

Since in the opposite direction the reduction of the retinal area stimulated, when carried to a certain point, results in the total disappearance of the color impression, we may say that the intensity of the latter is related throughout all its degrees to the area over which the stimulus is spread. It is not seen at its full intensity as soon as it is seen at all, but parallel with the enlargement of its area presents a series of intensive increments which at first are very rapid as the color area extends beyond the threshold, and afterward very slow; so that a spot of color just clearly discernible is scarcely less intense than the larger areas to which our ordinary experience is limited. The intensity of the color element in a given visual extent, however, is always less than that of any greater area having the same objective constitution, so that we should call only that color field fully saturated which extends to the whole field of vision.

The value of the differential factor of neutral light increases in the following color order: Red, Blue, Yellow, Violet, Orange, Green; in other words there is least difference in saturation between small and large areas of red, of all the colors observed, and most difference in the case of green. Therefore the influence of the number of elements stimulated upon the intensity of the color sensation is greatest in the case of green, least in that of red. It will be recalled that in respect to energy these two colors form the opposite terms of the series (according to Langley's determinations), green possessing the greatest and crimson the least energy.

To the preceding series of experiments was added a set of observations on the relation of brightness intensities in neutral light when distributed over different areas. The phenomenon presented here is not the same as in the case of color, since in comparing neutral brightnesses the background is homogeneous in quality with the areas to be observed, in so far as it must possess the element of brightness. The so-called brightness is therefore virtually contrast with the gray background against which the area in question appears, and in reading the results one must estimate the various quantities as degrees of divergence in either direction from this zero-point.

The screen employed was that used in the preceding set of experiments; it corresponded approximately to a gray produced by the combination of black and white in the proportions, 270°, and 90°. In the series of brightnesses descending from this positive degree of illumination only one point was determined, while three were tested in the series ascending toward white, giving five combinations, having the following amounts of white in angular magnitudes: 0°, 90°, 180°, 270°, 360°. The proportions which gave equivalent subjective brightnesses for the three experimental areas are as follows:

1 sq. cm.	4''	16''	
0.0°	5.5°	9.7°	deg. white.
90.0°	102.5°	90.0°	" "
180.0°	189.5°	171.5°	" "
270.0°	250.5°	241.5°	" "
360.0°	315.0°	296.5°	" "

In the first combination of the series the relations to be predicted are found to hold. The illumination of the experimental area in this case is less than that of the screen and its face appears dark in contrast with the lighter gray back- und. The degree of this contrast increases with each incre- t of area; in other words, the darkness of the larger sur- ppears more intense both in the relation of the smaller ble to the unit and in that of the larger variable to the er. In the second combination of slightly weaker illumi- than the background, and the third which was next it, no definite direction of change is manifested, as be expected. In the fourth and fifth of the group,—in f which the illumination of the experimental areas was distinctly greater than that of the background,—the dependence of contrast intensity upon area again appears definitely. It is to be observed that this influence increases in degree as the absolute difference between foreground and background grows greater. The amounts of black introduced in the several combinations give the following series of percentual values for the first and second variable areas respectively:

W 180	W 290	W 360	Area.
5.0 %	7.4 %	12.5 %	4 sq. em.
	10.7 "	17.7 "	16 " "

The figures present an approximation to the relations formulated in Weber's law, but it is questionable if a more extended series would continue the curve.

III. THE QUANTITATIVE RELATIONS OF STIMULATION AREA AND COLOR THRESHOLD IN DISCRETE AS COMPARED WITH CONTINUOUS EXTENTS.

In connection with a series of experiments upon the quantitative values of the color thresholds of homogeneous light, and of the visibility of such light qualities against colored backgrounds, it became important to compare quantitatively the color threshold depending upon a continuous extent of color with that arising from the distribution of the color in isolated spots over a larger field. It is the latter point only which is to be reported here.

The colors used and the conditions of lighting were as in the preceding experiments. Thresholds were tested for four colors only: red, blue, yellow and green; but to avoid inferential judgments some twelve qualities in all were used. The stimulation areas were controlled by means of sliding screens of dull, black-faced paper, so arranged as to present always a square. The observer sat a distance of six meters. The results are given in terms of square millimeters, and represent the average of five determinations. Two observers took part in the experiments.

The square area was first divided into two equal parts by a diagonal band of black, made successively two, five, and ten millimeters in width. With this arrangement determinations of red only for one observer, and of red and green for the other, were made. The results follow:

Obs.	Solid	2 mill.	5 mill.	10 mill.	
A.	48	35	30	15	Red.
B.	[1]160	116	120	78	Red.
	90	72	69	16	Green.

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[1] The relations of absolute magnitude in the two observers, or in different colors, have no significance, since the determinations were made by daylight and only single series could be made under conditions of approximately constant illumination.

The area was next divided into four equal sub-areas by two diagonals having successively the widths of two, five and ten millimeters as before, with the following results:

Obs.	Solid	2 mill.	5 mill.	10 mill.	
A.	48	48	40	25	Red.
B.	160	145	99	40	Red.
	90	65	64	42	Green.

The stimulus was then distributed in the form of circular areas two millimeters in diameter, which were arranged in vertical and horizontal rows separated by successive distances of two, five and fifteen millimeters, with the following results:

Obs.	Solid	2 mill.	5 mill.	15 mill.	
A.	48	43	28	25	Red.
	94	18	15	12	Green.
B.	160	39	48	31	Red.
	90	25	37	28	Green.

Two other modes of distributing the stimulation-area were added to those already described, but as the results in each case were analogous to the preceding, they need not be repeated. The determinations of the thresholds for solid extents were made some weeks earlier than the rest of the results quoted. This may account for the great reduction of the threshold for red in B's results. Figures for blue and yellow are not given. Yellow could be discriminated (from white) only when a larger area was presented than could conveniently be arranged for with the apparatus used. The determinations of the thresholds for blue were very variable and unreliable on account of a similar constant confusion with black.

The quantitative relations presented by the tables may be stated in a word, since the same essential curve is exhibited by all. The maximum value of the threshold is reached when the color forms a solid extent. Its minimum value, within the range of conditions included in the present observations, is found when the area is sub-divided and its parts are most widely distributed over the retina. Between these two limits value of the threshold increases and decreases as the con- ent areas approach aggregation or depart from it. It rs then that color is most readily perceived not when it ne continuous field but when it is distributed as sepa- tches within a larger area. An extent which is far he limits of visibility under the former conditions may clearly discriminable when it forms a group of smaller ots. The influence of magnitude in the constituent not so clearly shown as is the factor of separation hese parts.

If we abstract from the fact of local variations in the sensitiveness of the retina to color stimulation we should interpret the present results as indicating that any effect of reinforcement which the stimulation of individual points of the retina has upon the total effect produced is greater when these points are separated by unstimulated elements. If the important factor in such cases is the number of sensitive elements stimulated, and not the intensity of excitement aroused, the condition of distribution presents more favorable relations for perception than aggregation. The positive stimulation of any restricted portion of the retina affects also the adjacent unstimulated parts. The total irradiation effect thus produced must depend upon the proportion of stimulated points which are adjacent to elements not directly stimulated. This reaches its minimal value when the points immediately excited form a continuous extent. It would theoretically attain its maximum when each physiological unit was in isolation, but the practical limit may depend upon the co-operation of a variety of factors. This is sufficient to explain the results here presented.

It is possible that the phenomenon is due to an entirely different cause, namely the curve of color sensitiveness presented by a radial series of retinal points. The lowering of the threshold which follows upon dispersion of the stimulated points would then be dependent upon the increased sensitiveness of the elements stimulated under these conditions over that of the foveal area affected when the color formed a continuous extent. A definite curve for the color blue would have important bearing upon this point; but, as has already been stated, this set of tests was too variable to be depended upon.

NOTE. The observations collated in these two reports were made by Messrs. Bacon and Johnson, Davison and Phipps.

AN INVESTIGATION OF FECHNER'S COLORS.[1]

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TABLE OF CONTENTS.

Page.
I. Statement of Problem, ... 488
II. Literature, ... 490
III. Apparatus and Method, ... 494
IV. Experiments and Results, ... 499
  § 1. Introduction, ... 499
  § 2. General Conditions, ... 500
    a. Attention, ... 500
    b. Fatigue, ... 500
    c. Practice, ... 501
  § 3. Rate of Rotation, ... 502
  § 4. Length of Line, ... 502
  § 5. Variation of the Size of Sectors, . . . 506
  § 6. Width of Line, ... 510
  § 7. Effect of Position, ... 511
  § 8. Contrast: Effect of Gray Screen, . . . 512
  § 9. Daylight and Decrease of Lamp-light, . . 514
  § 10. Colored Background, ... 515
    a. Red, ... 515
    b. Green, ... 516
    c. Blue, ... 517
    d. Yellow, ... 517
    e. Two colors, ... 518
V. Theory, ... 520

I. Statement of Problem.

If a disc composed of black and white sectors is rotated with a moderate degree of rapidity, colors appear upon the anterior and posterior edges of the sectors. In other words, when excitation by black and excitation by white precede or follow each other at certain distances, whether these distances are determined by width of sector or by rate of rotation, there does not result a gray, as one might suppose, but color. The name of *Fechner's Colors* was first applied by Brücke[2] to the colors produced by rapid alternation of black and white, in honor of the discoverer of the phenomena.[1]

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[1] [The author of this paper was, unfortunately, seized with illness at the conclusion of her experimental work, so that she has been unable to give the article its intended form. Chs. I-IV have received some revision; ch. V is little more than a rough draft of the discussion as originally planned. Since the author cannot return to the work in the near future, I have thought it best to publish her MS. as it stands. —E. B. T.]

[2] Brücke, Ernst: Wiener Akad. Berichte, XLIX, 1864, 21-24.

The colors frequently appear under conditions not standardized; *e. g.*, if we glance up suddenly, we see colored borders on the window-frame; the edges of the leaves of our book are colored while we are in the act of turning them; or the edges of the printed line are colored as our eyes move rapidly up or down the page. That is, one of the essential conditions upon which the production of the colors depends is movement; color appears when there is not perfect accommodation of the eyes.[2] But under standard conditions, when the sectors of the disc are equal and of definite size, when the rate of rotation is regulated, and when the degree of illumination is kept constant, certain colors will appear in certain places, and with variation of one or more of the conditions the colors will also vary *in a definite direction*.

Since 1838 many means have been devised for the production of the colors. The most convenient way of obtaining alternation of black and white is to use a pasteboard disc composed of sectors of different sizes. The disc can easily be rotated, and its speed can easily be regulated,—both by means of apparatus which can be kept constant through long periods. It permits of many variations in division of sectors as regards size and position. Papers of different colors or brightnesses may be put on it, or sectors of the disc may be cut out.

The difficulty, indeed, has not been to find ways of obtaining the colors, but to find the explanation for them. More than half a century has elapsed since Fechner made his experiments, and during this time scores of articles concerning intermittent stimulation of the retina have been published; but as regards the cause we may even now agree with Fechner and Brücke that we know more at the beginning than we know at the end of our investigations.[3] This result is, of course, due to our general ignorance of the exact processes which take place in the retina during and after stimulation. Experiments have been made to show that the periods of rise and fall are different for different colors.[1] In another way, retinal inertia is shown by means of rapid alternation of stimulation.

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[1] An article by Sir David Brewster, in the Philos. Mag., N. S. IV, 1834, describes some effects of rapid changes of retinal stimulation. This is probably the one discussion in scientific literature which might be considered a previous description of the facts noted by Fechner. But Brewster's article could with little justice be said to record the discovery of the phenomena in question, for the explanations are different, not to our point; and both discs and experiments were made with a different end in view.

[2] The instance in question is not similar to that of von Bezold's rings, dependent upon fixation. Helmholtz, Phys. Op., 2nd Ed., 156.

[3] Brücke, Ernst: Pogg. Ann., LXXXIV (whole ser. CLX), 1851, 418.

II. LITERATURE.

As early as 1838, there appeared an article by G. T. Fechner, *Ueber eine Scheibe zur Erzeugung subjectiver Farben*, in which he describes the disc by means of which he first produced these subjective colors.[2] The fact that Fechner discovered the phenomenon quite accidentally does not lessen its interest for us, since the description of the observations is given very fully. Fechner had prepared a disc with 18 concentric rings for the production of different shades of gray; but upon its rotation he was astonished to see a series of colors. They were not of great intensity, yet were not without a certain vivacity. He found that the colors were perceived by different persons with unequal clearness,—a fact which, in view of their subjective nature, was not considered at all surprising. The reason for the result he found in the fact that the effect made by white light does not die out with equal rapidity for all rays of which it is composed.

Much later than the appearance of the article by Fechner, Helmholtz describes the production of a "flight of colors" by means of a black and white disc.[3] When a part of the retina is exposed to rapid alternations of white light and of darkness, causing successive states of increasing and decreasing excitation, the moment of maximal excitation is not the same for all colors.

Helmholtz made use of two sorts of discs: the one consisting of a black spiral line on a white ground; the other a disc half black and half white, whose sectors were divided to form three concentric rings, the center ring divided so that its sectors formed halves, the second fourths, the outer eighths. Upon rotation, red appeared upon the anterior border of white, blue upon the posterior border. With decrease of illumination the red became orange, the blue violet. With increase, the red became rose, the blue a greenish-blue. With increase in rate of rotation, the colors passed through rose-violet to green-gray, and finally assumed an appearance similar to that of watered silk. These phenomena did not appear immediately, but only after practice, and a certain state of fatigue seemed necessary for their production. From these facts Helmholtz derived the conclusion that the moment of maximal excitation varies with the color, coming for red and violet sooner than for green.

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[1] Kunkel: Arch. f. d. ges. Physiol., IX, 1874, 197.

[2] Pogg. Ann., XLV, 1838 (whole ser. CXXI), 227-232.

[3] Phys. Op., Ed. 1, 1867, 380; 2nd Ed., 1896, 530.

Aubert[1] verified the results obtained by Fechner almost as soon as they were published, and in addition noted the importance of one of the conditions necessary for the production of these colors, namely, the velocity. Extensive and accurate experiments were made to determine the exact rate which gave the most luminous colors. Aubert's general result is that too rapid or too slow rotation of the discs produces no color. These results will be discussed later in more detail.

Dove[2] does little more than report the results obtained by Fechner, although his work upon subjective colors produced by other means makes valuable additions to psychological optics.

J. Smith[3] describes the production of very brilliant luminous colors by means of rings of white or black. This is all that is of value for us; the author himself expresses the belief that the production of colors by such means overturns all accepted theories of light. He believes the experiments to be original.

Rood,[4] like Dove (pp. 171-7), obtained only lustre by alternating rather large masses of black and white. No colors are described.[5]

In 1881 a preliminary report upon the problem was made by F. J. Smith.[6] He used an ordinary wheel in making his experiments, and reports that there is an apparent relationship between spoke-interruption and wave length. Hannay experimented with a black and white disc, and came to the conclusion that response to stimulation is quickest for red; then follow green and blue[7]. He thinks that a passive observation adds to the brilliancy of the colors. This article was criticised by Napier Smith, who asked how the explanation given by Hannay accounted for the fact that black and white mixtures produce different colors, and why a certain movement should give red and the reversal blue.[8] If, however, Smith understood his discs, he would not find occasion for surprise in the fact that reversal gives a different color. To reverse the disc means to reverse the conditions. There would rather be reason for surprise if the phenomena remained constant while the conditions varied.

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[1] Aubet, H.: Physiologie der Netzhaut, 1865, § 161, 377-380. Less detail in Græfe's Hd. bh. der Augenheilkunde, II, 1876, 560. Also referred to as the Grundzüge der physiologischen Optik.

[2] Dove, H. W.: Farbenlehre, 1853, 281-283.

[3] Smith, John: Reports of Brit. Asso., XXIX, 1859, 22.

[4] Rood, O. N.: Am. Jour. Sc. (Sillman's Jour.), Ser. II, XXXV, 1865, 375.

[5] [*Cf.*, however, Rood's Modern Chromatics, 1879, 93 ff.; Text-book of Color, 1881, 93 ff.]

[6] Smith, F. J.: Nature, XXIV, 1881, 140.

[7] Hannay, J. B.: Nature, XXV, Apr. 1882, 604.

[8] Smith, Napier: Nature, XXVI, May 1882, 30.

No strenuous efforts were made to solve the problem of these subjective colors for several years, until 1894, when there appeared a disc made by Benham upon a plan somewhat different from those used heretofore, which brought out the colors with astonishing clearness. The phenomena of the disc were for a few years vigorously discussed in English and American scientific literature.

The fact either that the new discs were made upon a plan widely differing from that of the old discs, or that the colors were greatly intensified by the use of fine lines rather than of large blocks of black and white, so disguised the old phenomena that they were not recognized. The greater part of the later investigations are reported as if they concerned entirely new phenomena. The 'top' appealed to many as a new problem calling for solution. The new disc, or top, is one half black, the other half white. The white half is divided into three sectors of 60° each, or four of 45° each; each angle is subtended by groups of arcs, whose radii increases arithmetically from center to circumference. This arrangement produces colors which vary from distinctly brilliant and luminous qualities to shades and tints which are disputable as regards both name and mere existence. The layman who is asked to describe a certain disc will often name the colors as accurately and unhesitatingly as the scientific observer who is more or less prejudiced by expectation.

Soon after the appearance of the disc, which has been given the name of the *artificial spectrum top*, many explanations of the phenomena were offered. One of the first attempts at explanation was made by G. D. Liveing, who exhibited the top before the Philosophical Society of Cambridge.[1] He observed that if *black* is *followed by white* at not too great rapidity a sensation of red results; if *white* is *followed by black* a sensation of blue is aroused; if black and white follow each other rapidly, drab or a neutral green is seen. These are practically the results obtained under similar conditions by all observers.

Regarding the fact there is no dispute; regarding the explanation there is scarcely any agreement. Liveing's explanation called forth almost immediately criticisms or alternative explanations from Abney,[2] Finnigan and Moore,[3] Benham,[4] and Bidwell,[5] besides notes calling attention to modifications in the preparation of the disc.

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[1] Liveing, G.D.: Cambridge Phil. Proc., Nov. 26, 1894. Also Nature, LI, Dec. 13, 1894, 167; LI, Dec. 27, 1894, 200.

[2] Abney, Capt. W. deW.: Nature, LI, Jan. 24, 1895, 292.

[3] Finnigan, J. M., and Moore, B.: Nature, LI, Jan. 24, 1895, 292-3.

[4] Benham, C. E.: Nature, LI, Dec. 27, 1894, 200.

[5] Bidwell, Shelford: Proc. Roy. Soc. London, LX, 1896, 368-379.

Only the various explanations will be taken into account here. Strangely enough, it was not until after a long discussion that Edridge-Green called attention to the fact that none of the previous writers seemed to be aware that Helmholtz had explained the phenomena in detail.[1]

Liveing explains the phenomena by saying that the impression made upon the retina by a bright light remains for some time after the cause of it is removed, and that different colors are perceived with different rapidities. Red is perceived with the greatest rapidity; the impression of blue has the longest duration; the overlapping of these sensations produces the neutral tint, a sort of gray-green. No evidence for these facts, other than the phenomena in question, is given.

Abney thinks that the phenomena would be sufficiently accounted for if the order of persistence of the three colors were violet, green, and red.

Finnigan and Moore suggest as causes irradiation (although this seems to be ruled out by the fact that change in rate of rotation causes change in color), and contrast with the surrounding white field.

Bidwell made more extensive experiments than any other of the recent investigators, but made them mainly for the purpose of showing that the solution of the problem is to be sought in the fact of sudden changes in illumination. To say this, however, is merely to point out what the problem is. In the way of explanation, Bidwell comes to the conclusion that red is without doubt due to sympathetic excitation. Blue, he says, may be due to excitation of the nerve-fibres in the neighborhood of those excited by the direct action of light; or it may be due to the scattering of light by imperfectly transparent media. He prefers to suspend judgment with regard to blue. But at any rate, he declares, the experiments show that red originates in a part of the retina not exposed to light, blue in a part where light has not ceased to act.

Rivers gives a short historical account of the phenomena.[2] He is inclined to doubt the validity of the explanations offered by Helmholtz and Fechner and to accept Bidwell's theory, although, he says, the distinctness of the red in Bidwell's experiments is to be expected if this color reaches its maximum with the rapidity ascribed to it by Kunkel.[3]

Bowditch, also, scarcely more than notes the phenomenon:[4] "when the image of a white object is moved across the retina it will appear bordered by colored fringes, since the various constituents of white light do not produce their maximum effects at the same time;" . . . there would then appear "colors which vary with the rate of rotation and with the amount of exhaustion of the retina."

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[1] Edridge-Green, F. W.: Nature, LI, Jan. 31, 1895, 321.

[2] Rivers, W. H. R.: Schæfer's Text-book of Physiol., II, 1900, 1074.

[3] Kunkel: Arch. f. d. ges. Physiol., IX, 1874, 197.

[4] Bowditch, H. P.: Am. Text-book of Physiol., 1896, 789.

This review of the literature shows us that there are three well-marked periods during which the phenomena of Fechner's colors have been investigated, but that scarcely any advance has been made beyond the results obtained by the original investigators of the problem, except as regards the *preparation of the discs* for the production of the colors. The reports have been cursory, and no one has attempted a systematic explanation in terms of current theories of visual sensation.

III. Apparatus and Methods.

Work was carried on in the Cornell Laboratory from the fall of 1898 until the spring of 1891. The major part of the experiments were made in a dark room, for the purpose of securing an approximately constant and easily regulable light; during only a few experiments were the discs illuminated by diffuse daylight. The greater part of the experiments were performed during the morning hours.

The power by which the discs were rotated was obtained from a Crocker-Wheeler motor, whose speed was reduced by a Pillsbury speed reducer. From this a belt ran to a Zimmermann mechanical color-mixer, which was made to rotate at the rate of 4.3 rotations in the 1 sec. The rate was tested at the beginning of each experimental hour, and often during the hour, although a variation of one or two rotations from 130 in the half-minute did not cause any appreciable change in color quality.

The observers sat close to a large black screen which stood 55.2 cm. from the disc, and in which was an opening of 21 x 15.5 cm. Behind this screen, and 43 cm. from the disc, was a Welsbach gas-burner, which furnished the whitest steady light that could be found. The black screen was protected from the heat of the lamp by a white abestos screen, which acted further as a reflector.

The following lists describe the discs in such a way that duplicates may easily be made. (For the general appearance of the discs, *cf.* Fig. 1 of the plate; for variations of the conditions, *cf.* the list of discs.) The columns lettered A, B, C, D, designate the *sector* in which a certain ring is found. The sectors are lettered *from right to left*. The figures which follow the color named stand for the *ring* which will be made when the disc is set in motion; while the color-name itself stands for the quality which lines, drawn in the position designated, will give rise to after the disc has been set in motion. For the sake of greater convenience, in order to designate the position of the ring we shall use the name of the *color* which will appear to the normal eye while the disc is being rotated. Thus we see that, while the position of the sectors must remain constant, the position of the rings may vary within certain limits. For example,—to anticipate a little,—red and blue lines must appear in either sectors 1 or 4, but may extend through 2 or 3; green and yellow must appear in sectors 2 or 3, but cannot extend entirely through 1 or 4 without destroying their peculiar conditions. On the other hand, the groups of arcs may be at any radial distance from the center, and still fulfill the conditions necessary for the production of a certain color. Unless express statement is made to the contrary, the discs are divided into either 3 or 4 sectors, with 3 or 4 rings. Each ring is usually made up of 4 lines 1 mm. wide, the lines 3 mm. apart, the groups 5 mm. apart, the first group 10 mm. from the center. The color-names in parentheses denote the colors of the background. (The 'primary' colors are those of Bradley's colored-paper series.)

	A.	B.	C.	D.
1.	Red, 1	Green, 2	Blue, 3	
2.	Red, 1	Green, 2	Blue, 3	
3. Divided into quarters.	Red, 1	Green, 2	Blue, 3	
4. 3 broad lines.	Red, 1	Green, 2	Yellow, 3	Blue, 4
5. 5 & 6 1 mm lines.	Red, 1	Green, 2	Yellow, 3	Blue, 4
6. 3 fine lines.	Red, 1	Green, 2	Yellow, 3	Blue, 4
7. 2 broad lines.	Red, 1	Green, 2	Yellow, 3	Blue, 4
8. 3 fine lines overlapping sectors.	Red, 1	Green, 2	Yellow, 3	Blue, 4
9.	Red, 4	Green, 3	Yellow, 2	Blue, 1
10.	Red, 1	Green, 2	Yellow, 4	Blue, 3
11.	Red, 3	Green, 2	Yellow, 1	Blue, 4
12.	Red, 3	Green, 1	Yellow, 4	Blue, 2
13. Short lines.		Green, 2, 4, 5	Yellow, 1, 3	
14.	Red, 1, 3,			Blue, 2, 4
15.		Green, 1, 2, 3, 4		
16.			Yellow, 1, 3, 4 Blue, 2	Blue, 2
17.	Red, 2, 4	Red, 2, 4 Green, 1, 3		
18.	Red, 4	Red, 4	Yellow, 1, 3 Blue, 2	Blue, 2
19.			Yellow, 1, 2, 3, 4	½ sector. Green, 1, 2, 3, 4
20. Last ½ sector.	Green, 4	Green, 4	Yellow, 1, 3 Blue, 2	½ sector. Green, 1, 3 Blue, 2

21.			Green, 1, 2, 3, 4	Green, 1, 2, 3, 4	
22.	1 cm. line.	Red, 1	Green, 2	Yellow, 3	Blue, 4
23.		Red, 1			
24.		Red, 1	Green, 2		Blue, 3
25.		Red, 1, 2, 4	Red, 2, 4 Green, 3	Red, 4	
26.	Movable black sector.	Red, 1	Green, 2	Yellow, 3	Blue, 4
27.	See Plate.				
28.	$\frac{1}{16}$ black.	Red, 1	Green, 2	Yellow, 3	Blue, 4
29.	$\frac{1}{8}$ black.	Red, 1	Green, 2	Yellow, 3	Blue, 4
30.	$\frac{1}{4}$ black.	Red, 1	Green, 2	Yellow, 3	Blue, 4
31.	$\frac{3}{8}$ black.	Red, 1	Green, 2	Yellow, 3	Blue, 4
32.	$\frac{5}{8}$ black.	Red, 1	Green, 2	Yellow, 3	Blue, 4
33.	$\frac{3}{4}$ black.	Red, 1	Green, 2	Yellow, 3	Blue, 4
34.	$\frac{7}{8}$ black.	Red, 1	Green, 2	Yellow, 3	Blue, 4
35.	Plate.	Red, 1	Green, 2	Yellow, 4	Blue, 3
36.	Plate.	Red, 1	Green, 2	Yellow, 4	Blue, 3
37.	Plate.	Red, 1	Green, 2	Yellow, 4	Blue, 3
38.	Plate.	Red, 1	Green, 2	Yellow, 4	Blue, 3

Discs with colored back-grounds.

I—1.	Red, 1 (red)	Green, 2 (red)	Blue, 3 (red)	
I—2.	Red, 1 (green)	Green, 2 (green)	Blue, 3 (green)	
I—3.	Red, 1 (blue)	Green, 2 (blue)	Blue, 3 (blue)	
I—4.	Red, 1 (yellow)	Green, 2 (yellow)	Yellow, 3 (yellow)	Blue, 4 (yellow)
II—1.	Red, 1	Green, 3	Blue, 2 (red)	
II—2.	Red, 1	Green, 2	Blue, 3 (green)	
II—3.	Red, 1	Green, 2	Blue, 3 (blue)	
II—4.	Red, 1	Green, 2	Blue, 3 (yellow)	
II—5.	Blue, 4	Yellow, 3	Green, 2	Red, 1 (yellow)
III—1.	Red, 1	Green, 2 (red)	Blue, 3	
III—2.	Red, 1	Green, 3 (green)	Blue, 2	
III—3.	Red, 1	Green, 2 (green)	Yellow, 3 (green)	Blue, 4
III—4.	Red, 1	Green, 2 (Blue)	Blue, 3	
III—5.	Red, 1	Green, 2 (blue)	Yellow, 3 (blue)	Blue, 4
III—6.	Red, 3	Green, 1 (yellow)	Blue, 2	
III—7.	Red, 4	Green, 3 (yellow)	Green, 2 (yellow)	Blue, 1
IV—1.	Red, 1 (red)	Green, 3	Blue, 2 (red)	
IV—2.	Red, 1 (red)	Green, 2	Yellow, 3	Blue, 4 (red)
IV—3.	Red, 1 (green)	Green, 3	Blue, 2 (green)	
IV—4.	Red, 1 (blue)	Green, 2	Blue, 3 (blue)	
IV—5.	Red, 1 (blue)	Green, 2	Yellow, 3	Blue, 4 (blue)
IV—6.	Red, 1 (yellow)	Green, 2	Yellow, 3	Blue, 4 (yellow)
V—1.	Red, 1	Green, 2 (red)	Blue, 3 (red)	
V—2.	Red, 1	Green, 2	Yellow, 3 (red)	Blue, 4 (red)
V—3.	Red, 3	Green, 1 (green)	Blue, 2 (green)	
V—4.	Red, 1	Green, 2	Yellow, 3 (green)	Blue, 4 (green)
V—5.	Red, 1	Green, 2 (blue)	Blue, 3 (blue)	
V—6.	Red, 1	Green, 2	Yellow, 3 (blue)	Blue, 4 (blue)
—7.	Red, 1 (yellow)	Green, 2 (yellow)	Yellow, 3	Blue, 4
—1.	Red, 1 (red)	Green, 2 (red)	Blue, 3 (green)	
—2.	Red, 1 (red)	Green, 3 (red)	Blue, 2 (blue)	
—3.	Red, 1 (red)	Green, 2 (red)	Yellow, 3 (yellow)	Blue, 4 (yellow)
-1.	Red, 1 (green)	Green, 2 (green)	Blue, 3 (red)	
[illegible]	Red, 1 (green)	Green, 2 (green)	Blue, 3 (blue)	
[illegible]	Red, 1 (green)	Green, 2 (green)	Yellow, 3 (yellow)	Blue, 4 (yellow)

-1.	Red, 1 (blue)	Green, 2 (blue)	Blue, 3 (red)	
-2.	Red, 1 (blue)	Green, 2 (blue)	Blue, 3 (green)	
-3.	Red, 1 (blue)	Green, 2 (blue)	Yellow, 3 (yellow)	Blue, 4 (yellow)
-1.	Red, 1 (red)	Green, 2 (green)	Blue, 3 (red)	
-2.	Red, 1 (red)	Green, 2 (blue)	Blue, 3 (red)	
-3.	Red, 4 (red)	Green, 3 (yellow)	Yellow, 2 (yellow)	Blue, 1 (red)
-1.	Red, 1 (green)	Yellow, 3 (red)	Blue, 2 (green)	
-2.	Red, 1 (green)	Green, 2 (blue)	Blue, 3 (green)	
-3.	Red, 4 (green)	Green, 3 (yellow)	Yellow, 1 (yellow)	Blue, 2 (green)
-1.	Red, 1 (blue)	Green, 2 (red)	Blue, 3 (blue)	
-2.	Red, 1 (blue)	Green, 2 (green)	Blue, 3 (Blue)	
-3.	Red, 3 (blue)	Green, 2 (yellow)	Yellow, 4 (yellow)	Blue, 1 (blue)
-1.	Red, 1 (blue)	Green, 2 (green)	Blue, 3 (red)	
-2.	Red, 1 (blue)	Green, 2 (red)	Blue, 3 (green)	
-3.	Red, 1 (red)	Green, 2 (blue)	Blue, 3 (green)	
-4.	Red, 1 (blue)	Green, 2 (green)	Yellow, 3 (yellow)	Blue, 4 (red)
-1.		Green, 4	Yellow, 3 (yellow)	
-2.	Red, 4			Blue, 3 (red)
-3.	Red, 3 (blue)			Blue, 4
-4.			Yellow, 4	Blue, 3
	½ white, ⅜ black, ⅛ blue			
-5.		Green, 2	Yellow, 4	(red)
-6.	Red, 2 (yellow)			Blue, 3
-7.	Red, 2 (green)	Green, 4.		

Thus there were in the entire series 97 top discs,[1] and one called the Helmholtz disc,[2] all 15.5 cm. in diameter. 38 discs were simply black and white, with the arcs and lines varying as regards length and width, varying also as regards the number of lines in each group and the disposition of the groups within the different sectors. The remaining 58 discs varied from the others by having a part or all of the white semicircle replaced by one or more colors. As regards distribution of colored back-grounds, the arrangement was as follows: I 1-4 all sectors of same color; II 1-5 sector 4 (or 3 and 4 according as there were 3 or 4 sectors on disc) colored; III 1-7 middle sectors or sector colored; IV 1-6 sectors 1 and 4 of same color; V 1-7 sectors 2 and 3 of same color; VI 1-3 to XI 1-3 all sectors colored, each disc having two sectors of one color and one (or two) of another,—part with the two like sectors preceding (or following) the third, and part with the two like sectors including the third. XII 1-4 had 3 or 4 sectors of different colors. XIII 1-7 were made up of odd combinations, with a single colored sector and with only two groups of lines.

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[1] Part of the discs were made by Dr. J. E. Ives, now of the Univ. of Cincinnati, who began to study the problem at the Drexel Institute, Philadelphia.

[2] The figure given by Helmholtz, Phys. Op., 2nd ed. 195, Fig. 149.

The problems which arise with this arrangement of discs, besides the phenomena of colors, are (1) the effect of length of line upon the color, (2) the effect of width of line, (3) the effect of distribution of groups, (4) the effect of background color, (5) the effect of distribution and amount of background color. The last two are, obviously, problems of contrast effect. The part played by contrast was further investigated by cutting out (by use of a gray screen) all but one group of lines. The entire series was given once to each observer, who described the colors as fully and accurately as possible; this series was checked by a second, in which the colors were matched on the "Prang Standard of Color."[1]

Although useful as a check, this second series was not, on the whole, so valuable as the first. In the first place there were not on the chart enough combinations of saturation and brightness to match all the colors on the discs; this was especially noticeable with the "rich" navy blues. Here recourse was had to the Bradley colors; but even these were unsatisfactory. Further, the luminosity of the disc color was often greater than that of the chart, the chart color seeming by comparison to be "dead" or "dull." Changes in saturation degree from one plate of the chart to another were often more rapid than changes in the disc colors, so that the colors were said to be "between plates one and two," "two and three," etc. The matched colors were often supplemented by verbal reports.

Still, in spite of these difficulties, the reports may be said to be exceptionally accurate. This accuracy is vouched for by the fact that not seldom exactly the same chart color was chosen by two or more observers, though more often the same color tone was chosen, with a varying degree of saturation.

In the second series, the direction of rotation was changed, in order to prevent any expectation, and to bring out the effect of the position of the lines. As might be expected, this had no effect upon the color-tones, but merely changed their relative positions upon the dics, their brightness and their degree of saturation. In this series red appeared in sector D, green in sector C, yellow in sector B, and blue in sector A. The observer was frequently asked to rest, always, during the change from one disc to another, and, if the need was felt, during the observation of a single disc. On the average there were about eight discs studied during each experimental hour; at first less than this number, later more, the number varying with the observer and with the condition of the observer on different days. The observers were Mrs. I. M. Bentley (By.),

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[1] Prang chart, Pop. Ed., No. 1, Pub. by Louis Prang, Boston, Copyright 1898.

Miss L. Hempstead (H.), Miss M. F. McClure (M.), Dr. C. R. Squire (S.), Dr. M. F. Washburn (W.), Dr. W. C. Bagley (B.), Dr. I. M. Bentley (Be.), and Mr. R. M. Ogden (O.) (For the earlier experiments in diffuse daylight the observers were Dr. G. N. Dolson, Dr. C. R. Squire, and Mr. C. A. Perry.) Besides these, there were many who looked at only two or three discs; this was for the purpose of testing the "layman," as regards perception of the colors without expectation or fatigue.

IV. EXPERIMENTS AND RESULTS.

§ 1. INTRODUCTION.

The arrangements of black and white necessary for the production of the different colors are as follows. (1) Black *followed* immediately by white gives *red*. That is, there is a sensation of red at the first stage of excitation, brighter when the excitation is continued a *relatively* long time. The resulting sensation is made more vivid if there is co-excitation by black and white (*cf.* § 4, below).

(2) Black *both followed and preceded by* white gives rise to the sensation of *green*. *a*. If black is both followed and preceded by an *equal* number of degrees of white, the resulting color is *yellowish-green*. *b*. If black is *preceded* by *less* and *followed* by *more* white, the sensation is of a more saturated, more constant *green*. *c*. If black is *preceded* by *more* and *followed* by *less* white, the sensation is of a more yellowish, less constant green, called by us *yellow*.

(3) Black *preceded* by white gives rise to the sensation of *blue*. That is, there is a sensation of blue when the excitation by white has lasted for some time and is then suddenly cut off by excitation by black. The conditions for red and blue are distinguished by the position of the lines upon which the colors appear. Black is not cessation of stimulation, but a change in the character of the stimulation.

When the lines were so arranged as to fulfill the above conditions, the following reports were made:

TABLE 1.

Red was chosen	156	times	out of	157	99%
Green "	189	"	"	253	75%
Green or yellow "	159.5	"	"	240.5	66%
Blue "	149	"	"	164	91%

This general report necessarily leaves out of account the variations of tints and shades. These will be given with the more detailed reports.

Besides these differences, ascribed to individual peculiarities, there are also differences in color-quality caused by position (other factors remaining unchanged), by width and length of line. These problems will be discussed separately. The differences will be studied with each of the observers separately, so as to eliminate the indeterminable factor of natural individual differences; afterward, in order to determine the generality of any laws which may be found, the reports will be compared.

Before the special conditions are studied some of the more general conditions of observation may be noted.

§ 2. GENERAL CONDITIONS. *a*. ATTENTION.

It has been a question whether attention increases or decreases the brilliancy of the colors. This is a difficult question to answer. Perhaps it is best to answer it both affirmatively and negatively: affirmatively,—for we know that in general the effect of attention is to make the object of perception more clear and vivid; negatively,—because we know that attention fluctuates, and also because we know that the *fatigue* or *dissimilative* processes cause changes in the degree of saturation: there is light induction. We may say that attention aids in perception of color, that it clarifies the color, when not continued too long.[1] Red especially is brightened by being watched attentively. Attention seems to bring out the color when it is faint. (Be., S. and W., disc 25; B. and S., disc 27; By., discs 35-38). Closely connected with the question of attention is that of indirect vision. We saw that Hannay believes *passive* observation to be an aid in the perception of color. We can agree with him so far as to say that this is true occasionally,—but it is rather the exception than the rule. W. noted that, if she fixated beyond the disc, she could see all sorts of colors, rather mottled, covering the surface of the disc.

H. and O. noted that if they looked at the disc as a whole it had the appearance of being more generally covered with color than when they examined each separate ring. But the almost
nimous decision throughout the work was that *short periods*
attention aided in the perception of the colors.

b. FATIGUE.

; "attentively" deadens the color, if the gaze is con-
long. "Too long" depends, to begin with, upon the
of the color. If it is merely liminal, the color will
almost immediately (H., disc 6, ring 3; S. 29, ring

Phys. der Netzhaut, 1865, 162, says in discussion of this
f the ring itself be fixated it is gray, while the proximate
e.

4), or will change so that it cannot be matched (W. 1, ring 2; M. 9, 3 varied from III yyg 4 to B v; O. reverse of 10, 2). Very often the effect of fatigue is to make different lines of the same group appear in different colors; this was especially true of B., who scarcely ever showed general fatigue, but who showed it in this way more than the other observers. This change within the group, besides being due to fatigue, was also brought about by accidental variation of the lines. H. was especially sensitive to fatigue.

The Helmholtz disc, with its larger alternating masses of black and white, was more fatiguing than the finer alternating lines of the top disc. The disc was rotated 4.3 times in the 1 sec., at the same rate as the top discs. B., W., and O. reported on this disc, and all three reports were practically alike. Ring 1 was plainly divided into two sectors; the white was clearly tinged with yellow, and for W. had some red. Ring 2 for B. scintillated like mother of pearl, was yellowish with blue over it; for O., was blue and yellow, the yellow rather greenish,—the colors did not fuse but came in "daubs;" for W., the ring alternated yellow and violet-blue quite vividly. Ring 3 for all showed a great deal of yellow at the outer edge, as did the border of most of the other discs; for B. there was more yellow than in ring 2, and it grew yellower with gazing; there were flashes of blue-green very light and bright with dark shadows at intervals; for O., green and perhaps red were evident, but it looked as if there might be all colors 'if he could only pick them out;' for W., there were red and green, the latter a blue-green and quite bright; there was also a great deal of yellow at the edge. W. said immediately that the colors were fatigue effects, and noted this fact first in the increasing brightness of the whole disc, which disappeared after a rest. For both W. and O. all colors were gone from rings 1 and 2 after a rest; ring 3 "shimmered." For B. the colors came as rapidly as for the top discs.

c. PRACTICE.

We must dissent from Helmholtz' assertion that practice is necessary for the perception of the colors, as well as from the statement that fatigue is necessary.[1] There were both laymen and experienced observers to whom the colors were so brilliant at first glance as to cause exclamations of surprise. But in this connection individual differences appear. To those for whom the colors were brilliant at first, they were always brilliant. To those who had difficulty in noting color at all, the colors were always dull (there were none of these among the regular observers). H. probably showed the effects of practice more than any other. For her, the first three discs were black on the outer ring, with *possibly* a tinge of dark green; on the fourth disc there was a tinge of violet *at first;* discs 5 and 6 were black; disc 7 showed blue; 8 a green-blue. Afterward the green became less prominent, until it almost disappeared. Be. noted that the colors were better after looking awhile. For H. the lighter greens of rings two and three were very apt to change and hard to hold. O. saw the greens before any other colors, and his reports corresponded most clearly with the length of line. For W. the reds and blues were so brilliant that the greens by comparison could be said to have almost no color at all. The individual peculiarities continued throughout, so that they could not be said to be due to accidents of the discs.

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[1] *Op. cit.*, 530, Fr. 502.

§ 3. RATE OF ROTATION.

As is noted elsewhere, the effect of very rapid rotation is to produce a uniformly shaded surface. This effect was also studied by means of disc 3 which was divided into quarters. All of the colors became duller, "dirtier." Ring 3 (the outer one) was changed most. For B. it was a light green; H., black; M., black; O., black, maybe some blue; W., violet. Aubert gives an exhaustive account of the effect of rotation, working with the well-known disc with two divisions in ring one, to sixty-four in ring six.[1] When the discs are "slowing down," *i. e.*, when intermittence becomes less frequent, the colors change in brilliancy, and just before stopping, when the colors have entirely disappeared, the black lines appear very intense.

§ 4. LENGTH OF LINE.

This study was made with discs on which there were shorter or longer lines than was ordinarily the case. The discs used for this study were: 8, 13, 16, 17, 18, 19, 20, 21 and 25.

Red. When the lines are lengthened the color is darkened. Colors were matched 11 times; of these 9 were taken from plates IV or V, in comparison with choice from plates II and III, sometimes IV, chosen for discs 1 and 2. Of 30 reports, including verbal descriptions and matched colors, all but one modify the report "red" by adding "there is much blue," or "black," or "red on the border only."

In disc 25, ring 1 (passing through one sector), the red is faint; ring 2 (passing through two sectors) is a deep red, redder than 1; ring 4 (passing through three sectors) is only faintly shaded with red for S. Be. can "suggest" red better than green or blue; hence might suspect the presence of red.

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[1] Aubert: *loc. cit.*

W. reported "no blue at all," showing that red was not even remotely suggested to her. These results are quite in accord with the results obtained by varying the amount of black on the disc (*cf.* § 5). It is simply another way of changing the duration of stimuli.

Green. Here again the colors are darkened, with an occasional increase in saturation. H., *e. g.*, reports II g as a match for ring 3 disc 8 (lines 1 ¼ sectors long) when reversed. This is the only color chosen from a plate with very saturated colors. 25 times the colors were chosen from plates IV to VII, and only twice from plate III. The adjectives used were often such words as "dirty," "nondescript." The changes which occur here are also in harmony with the changes brought about by changing the size of the black sector. In disc 21, where the lines were preceded and followed by equal amounts of white, the reports were VyO, IVyyg1, Vyg1, but it was added that this was just at first; the colors soon became bluish. In the reverse of disc 19, where the lines passed through the first half of the fourth and all of the third sector, the colors were reported either as blue from the first moment, or as changing sooner than in other discs. H. reported all sets of 19 as varying from VII RRv to VI v, *i. e.*, as having only a faint tinge of color. W. reported all as gray. In the reverse of disc 20, B. reported ring 1 as V BG1, and ring 3 as V BG1 to VvRv1. H. reported ring 1 as V GBG, from memory, but after this first moment as VI Bv. For W. they were all gray with some red. Ring 4 of 20, with the clock-wise turning, was reported by B. as green with some red, by H. as "a very deep green which stays," by M. as "green and quite saturated," by O. as "a distinct green." The effect of the length of line upon the green is to *darken* it, but *not to decrease* it in *saturation*.

Yellow. It may have been noted that the yellows are almost never reported as pure yellow. If it is remembered that yellow where mixed with black gives a rather greenish effect, a "dirty, nondescript" color, this fact will not be counted against our theory. The reports upon green are often modified by the adjective "yellow." No less often is the report upon yellow modified by the adjective "green;" for a yellow mixed with a black is, by this decrease in brightness, given a greenish tone. Furthermore we are little accustomed to seeing this color mixed with black. A dark blue or a dark red is recognized as being mixed with black, and such mixtures are matters of everyday perception. The same is true, too, of green; but we do not often find yellow mixed with black. We have either the pure color or light yellow, "canary," "lemon," "corn-color," etc. The reports "dirty, faded green," "nondescript," etc., are almost always referred to some modification of yellow when these are matched. A special study of the yellows was made with the disc with a movable sector, also with discs 35-38. (The report is given below.) In disc 19, B. reports all sets as yellow, but very dark; but H., M., O., and W. report them as gray, not a dead black and white, but a gray modified by some color which they are unable to name. In disc 20, however, where there are other colors with which to contrast these same lines, ring 1 is reported by B. as olive-green, by H. as a green which soon becomes violet, by M. as dark green, by O. and W. as gray with some red. Ring 3 is reported by B. as having lines 2 and 4 a blue-green, and 3 a red-brown; H. and M. report a green which soon becomes violet; O. a black-gray; W. gray with some red. When disc 20 is reversed, ring 4 is reported by B. as V B3, by H. as VIvBv, by M. as IV Bv3, by O. as V Bv1, and by W. as being reddish.

This change into the blue tinge, which is always very faint and dull, is also in correspondence with the results obtained with the discs with the varied black sector. In order to eliminate the factor of black, and to ascertain certainly that green appeared on ring 2 and yellow on ring 3, a series of four discs was made such as is shown in the Plate, discs 35-38. At first glance By. reported ring 2 of disc 35 as green, ring 4 as a faded yellow-brown; later she said she believed it was a green-brown, but after looking again when rested said it was yellow-brown. Be. matched the second ring with IV GB6 or GBG6, adding that the disc color was a little lighter; and matched the fourth ring with IIIy6, adding that the disc was lighter than this, too. By. called ring 2 of 36 a "faint, washed out" green, ring 4 a green or yellow-brown. With indirect vision, or while looking at ring 2, By. could see green in ring 4. Be. hesitated about ring 2 for some time, wondering whether there was not some pink. He was expecting green, for the ring was next to ring 1 which was a very rich blood red. The red comes in ring 2 only occasionally, and has in it no purple. Ring 4 he called a light brown (*i. e.*, yellow in some gray), IIIyO6, and said it was darker than ring 2.

In disc 37 By. reported ring 2 as green, ring 4 as pink at first glance. Ring 4 soon grew greener and duller; but as she looked at ring 2, the color became brown again. Ring 2 matched most nearly IIIyG6, ring 4 matched IIIyO6. For Be. ring 2 was green at first (and he noted that it was greenest just as he "goes to look" directly), and after a rest matched IIIyG6 (just as By. had matched it); ring 4 was a yellow gray-brown, darker than 2, and maybe a little red. At first Be. chose IIIyO6 to match ring 4, but later changed to IIIy6, because the *yellow* was more prominent than anything else. In disc 38 the green of ring 2 was for By. much more yellow than before and easily lost its saturation; it was matched with IIIyy6; ring 4 was much darker than ring 2, was yellow-brown with the two inside lines "quite a good green," but matched IIIyO4. Be. matched ring 2 with IIIy6 as nearest; he added that it should be greener, but yyG6 was too green. He took some time to match ring 4. It was nearest IVy4, yet he said he was *sure* there was some green in it.

These results show quite clearly that it is green which appears most plainly in sector 2, even though it is a yellow-green. The yellow undoubtedly appears when the lines are in sector 3. The fact that both Be. and By. called ring 4 of 38 *green*, and were surprised when it matched a yellow, shows that there is a natural tendency to call yellow *green* when it is mixed with black. This result is also in harmony with the Purkinje phenomenon displayed by yellow when darkened.[1]

Of course, these colors were very light in comparison with the red and blue of rings 1 and 3, on account of the very short lines. The positions of the red and blue were kept constant, so that we could be sure that any change of color was due to changes in the lines themselves.

The relative values of the green and yellow were studied with W. and S. by help of disc 26 with the movable sector. The lines were thin and farther apart than usual, and three in each group. There was no decided green or yellow for W. at all. According to the method of minimal changes, the black sector was varied from ½ to $\frac{1}{16}$ and *vice versa*. When the disc was $\frac{5}{16}$ black, W. noted that there was scarcely any red in 1, and that the blue was very much bluer; with ¼ black, there was no more red in 1 than in 2; 3 was very much lighter than any of the others and bluish; the blue was much bluer.

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[1] An attempt was made to obtain, by use of the Hering mixer, some sort of an equation between the green of yellow when mixed with black, and green itself mixed with black. The experiments were made in day-light and with the Hering color papers. It was first determined that to yellow must be added 20° of black in order for the yellow to appear greenish. 16° of yellow must be added to the black before it begins to appear greenish. Black was then added to yellow and yellow to black in order to obtain the mixture which seemed to contain the greatest amount of green. This mixture was found, on several different days, to consist of 131° of yellow and 229° of black. With this mixture was equated the mixture of about 5° of white, 300° of black and 55° of green. 60° of green made the yellow appear to be reddish, a sort of orange yellow; while with 50° of green the yellow made the green appear to be blue. Hence in the former case there was too much green, and in the latter there was too much yellow. Accepting, then, the comparatively rough estimate of 55°, we may say that the color in the mixture of 131° of yellow and 229° of black might appear half green. We may say that the resulting color is a yellow-green or a green-yellow.

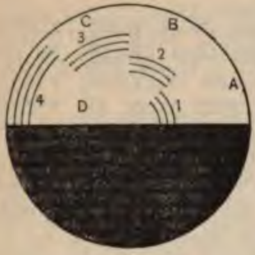
This was the same with the reverse. With S., when three was ⅛ black and the disc was being reversed, there was red-yellow on ring 3; with $\frac{3}{16}$ black, ring 3 was green-yellow. All the other rings were darker, but less distinct as regards color. This method did not prove to be so satisfactory as the one usually followed.

Blue. The effect of change of length upon the blue can be reported only in a general way, for it will be remembered that it was impossible to match the blues with any degree of accuracy. Very often the comparison was attempted, and in almost every case it was I B or BBv for saturation, but plate IV (or VI or VII) for brightness, as the case might be. We have all seen very rich dark blues, and know that mixture with black does not at all necessarily mean dullness or deadness, lack of lustre or life. It was noted, however, that when this change in brightness came there was often the remark, "now maybe I can match this." This plainly showed that a change was recognized. When disc 25 was reversed, ring 1 became a slightly green-blue, ring 2 was the usual violet-blue, ring 4 was faintly blue (perhaps by suggestion from rings 1 and 2) or black. For S., however, the ring took on the faint tinge of "chocolate" so often seen on the red lines. It is quite in the order of things that red should appear here, where we have a small section of white between black sectors and black lines,—but it is so faint as to be ordinarily overlooked, and is "suggested away" by the brilliant blues of rings 1 and 2. The change with the blue is again similar to the change with the discs carrying the small sectors of black. The blue is *dark*, but still *rich* in *saturation* and *luminous*.

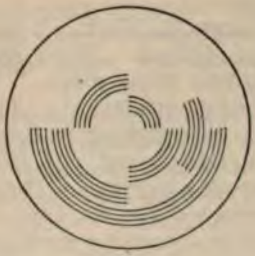
§ 5. VARIATION OF SIZE OF SECTORS.

After it was found that the length of the line caused some change in color-tone, a series of discs (26-34) was made in which the length of line was varied proportionately with the size of the sector. This proportionate variation was brought about by making discs on which the amount of black varied from 0 to ⅞. There was also a disc with the four groups of lines drawn as usual on the white, but with the black part made as a movable sector. This series of discs serves for a study of the length of lines, the effect of alternation and duration of stimuli, and also for a correlation of brightness of disc with the Purkinje phenomenon. Disc 27 is shown on the plate. On the remaining seven discs the white part is divided into four equal sectors, on which are drawn groups of arcs of the same size and radial distance as i
varying in length.

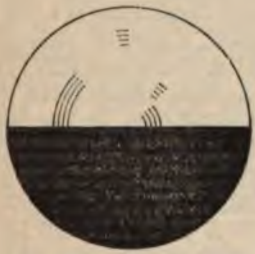
The disc which was ⅜ b



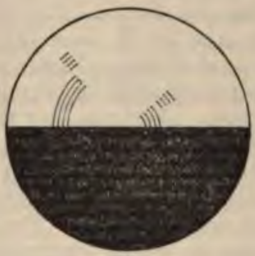
1



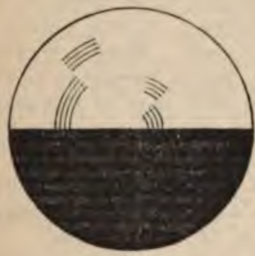
27



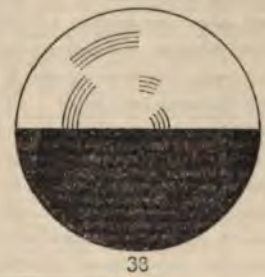
35



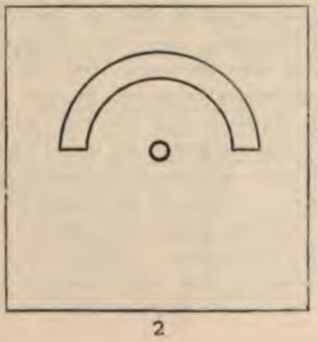
36



37



38



2

which were ½ black. Change took place most rapidly with *increase of black*. There was a significant change in the way the reports were given. It was the darkness which first caught the attention. (The observers were all inclined to describe any striking feature before beginning to give the systematic report, and not seldom there were exclamations of pleasure or surprise.) The disc which was ⅝ black was described as looking smoked, or as if the colors were deadened by being seen through a dark veil; the black seemed to "interfere" with the brilliancy of the colors. The red was darkened for all observers by the presence of black; the lines which were usually green took on a rather pinkish shade, and were described by Be. as IIyyO5 (a very light orange), by S. as VyyO3, and by W. as a yellowish-pink, a sort of pale salmon.

The most striking change was with the disc which was ¾ black. The first unstudied impression was a dull, unsaturated red, or faded pink. And the fact that the second ring had become the brighest red and the most saturated color on the whole disc invariably caused surprise. It was reported as V Rv4, V O5, most decidedly the reddest, unsaturated but unmistakably red, a faded but uniform red. The third ring was described by three observers as green (including W., who seldom saw any tinge of green), but by one was reported as pinkish, of the same general tone as the first and second rings but more faded.

The disc which was ⅞ black became upon rotation a dull, hazy red over its entire surface. Rings 1, 2, and 3 were all of a dull red shade, 1 least saturated, 3 most. Ring 4 was at first faintly green, of a very dark shade, but it turned to red if the observer looked too long. Through this part of the series we see that the blue and yellow lines are very soon changed as regards color-quality, and that the red especially, with short duration, tends to color all the lines. The colors are thus not *dependent merely upon their position* (alternation of stimuli) *but in addition upon the actual duration of the stimulation.*

When the amount of black was decreased, the colors tended to be of a saturation equal to that of the discs ½ black, with the green perhaps lighter. Be., for example, reported ring 2 as IVg when the disc was ⅜ black, and IIg when there was ¼ black. S. also reported vivid green for the latter disc, and by matching reported IIIyG; but for the former reported only IVyyg2, and described the green as more yellowish than when there was only ¼ black. W. made no distinction between rings 2 and 3 of these discs. The red and blue were both saturated, but the green and yellow lines were reported when there was ¼ black as rather violet-gray. With clockwise turning the green was faint on ring 2, but with reverse turning both were violet-gray. With ⅜ black, rings 2 and 3 were mottled red and very dark green; with reversal the reports for both rings were gray, with red here and there and possibly some green. At least the green for W., even though faint, was enhanced by darkness.

Ring 3 with the disc 3/8 black was different for all observers. It was hard to hold, therefore hard to match and to describe. It very evidently had an annoying, irritating effect upon the observers. They frequently asked to rest and hesitated for some time before reporting this ring as blue. Occasionally it was described as at first glance a faint yellowish-green, but this lasted scarcely more than a second. The verbal reports were blue, blue in gray, stone-blue, etc., but when the colors were matched they varied from IIIv1 with Be. to III BBv4 with S.

The disc which was only 1/8 black was accompanied by an unmistakably pleasant affective tone. The colors were reported as mixed with black, on account of the length of line, but the "spots" of color that could be separated from the black were described as *very* saturated and pretty. (It was noted that *pretty* was almost always applied to the more unmixed colors. Those that needed several adjectives to describe them, or that were hard to match, were reported more often as unpleasant, unsatisfactory colors.) The blue of ring 3 was reported as IIIvBv2 or v4, as not a very unsaturated blue or lavender.

When there was only $\frac{1}{16}$ black, the red became plum color, the green was still green although very dark, rings 3 and 4 were blue. The observers were asked not to look at the disc until it was in full motion although the change from more to less black was easily recognized. It was especially desired that they should know the construction of the disc with no black whatever, before the reports were given. The rings were reported at first as blues, or as black; but after attentive observation for a moment or two, rings 1 and 4 were reported as blue, rings 2 and 3 as green (3 perhaps as both green and violet). The green faded more quickly than the violet. There is no beginning or end to the disc. The alternation is the only feature which can differentiate greens from blues. Rings 1 and 4 may be either red or blue, but ring 4 will be darker because the lines are longer. S. was the only observer who reported a faint tinge of red in 4.

Although these subjective colors depend upon duration and alternation of stimuli, they are not all of the same saturation or brilliancy. We may permit ourselves to use the expression "mixed with black," because there are changes in saturation due to changes in the black sectors which govern the time for regeneration of the visual substances, and in the white sectors which change the duration of stimulation. The colors are mixed with black just as any subjective color is mixed with its background. In the discs the background is either black sector or black line.

It will be noted in the above that there is a striking illustration of the Purkinje phenomenon. With *increase of black* the long-wave end of the spectrum is emphasized; there is much red, but only little green. With *increase of white* the short-wave end of the spectrum is emphasized, the long-wave end is lost. But, contrary to the phenomenon under other circumstances, the green becomes very saturated (vivid myrtle) although very dark. Our brightest light is much more moderate than the light required to make the spectrum appear blue and yellow.

§ 6. EFFECT OF WIDTH OF LINE.—Discs 2, 4, 6, 7, 9 and 22.

We may report that, as a general rule, the width has little or no effect upon the color. If the line is very thin it may seem "hard to get hold of," not enough mass to give color; but this varies with the observers, some of whom prefer the broader, others the narrower lines. Slight changes in width had no appreciable effect. W., who saw "red edges" on almost every disc, continued to see red only on the edges when the width of the lines was increased. H. and M., who almost never saw red on the edges only, saw wide lines as entirely red. B. saw red edges on the fine lines of disc 6, not on the wide lines. Disc 22 certainly had lines wide enough to give a crucial test. Here B. did see red edges, the outer edge more saturated; Be. saw a yellow halo just outside the red ring, but the ring itself was a reddish-yellowish-brown; S. saw ring 1 as plum color; O. as a brown-gray, lighter at the edges; W. saw it with red edges as usual. But for all the second ring was greenish, the most saturated on the disc, colored *all the way through*. For W. there was some green in it. Ring 3 was a blue-gray for all, for B. and O. it was lighter at the edges, for W. bluer. Ring 4 was a deep violet for all, especially marked at the inner edge. These lines are so wide that they might very well show contrast with the surrounding white field, while on the narrower lines this contrast would not exist separately from the general color-tone of the whole line. That red should appear at the edges is quite in harmony with our statement that red appears with cessation of a black sector or with beginning of excitation.

We choose at random a few cases to illustrate our statement that width has no especial effect upon color: discs, 2, 4, 6, 7.

TABLE II.

Red.	B.	H.	M.	O.
2.	IV RRv	III Rv	III Rv	IV RRO
4.	III RRv5	IIv Rv4	III Rv3	IV Rv4
6.	II Rv	III Rv	IV R1	IV RRO3
7.	III Rv1	IIIv	IVvRv	V RO1

TABLE II.—*Continued.*

Green.	B.	H.	M.	O.
2.	VgBg	IIyg	IIIyg2	IVyyg
4.	Vyg5	IIIyO3	IIIyg1	IVyg
6.	IVgyg5	IIIgyg1	IVgyg2	IVyg3
7.	IIIg3	IVg2	IVyg1	IVyyg2

§ 7. EFFECT OF POSITION UPON THE DISC.

There is at least one very striking effect due to variation of position of the rings upon the disc. The commonest arrangement is that represented by Fig. 1 of the Plate, and this is the best arrangement. We stated at the beginning of our investigation that reversal of the direction of rotation of the disc had no effect upon the general color-tone. It has, however, an invariable effect upon the shade or tint of this tone. The first ring of Fig. 1, when not reversed, gives a brilliant blood-red; but when the direction or rotation is reversed, the red becomes brownish or purple, *i. e.*, tinged with blue. The fourth ring, when not reversed, gives a brilliant, luminous and rich blue; but when reversed a duller, more violet blue. In other words, when there is reversal, the red appears in ring 4, where there is the same proportion of black and white as in ring 1, but where there is an *increase* in the *actual amount* of *white;* the blue appears in ring 1, where there is an actual *decrease* in *stimulation.*[1] This is again in accord with the results obtained with the series of discs made with greater and lesser amounts of black (*cf.* § 5). For example: B. described ring 1 of disc 1 as brilliant blood-red, but upon reversal it became III-RRv; H. described the same ring as a brilliant lavender, luminous purplish-pink, but also chose III RRv; M. chose IV R to match this ring, while before reversal W. chose II R. Disc 5 ring 4 B. described as indigo, but matched it upon reversal with IV B. Disc 5 ring 4 O. described as black, but on reversal matched ring 1 with I BBv. Disc 6 ring 2 H. described as a "deep, rich green which very seldom changes," but upon reversal matched ring 3 with IIIgyg1, and added "it soon loses its green." The same green M. described as "quite satisfactory, best green so far," but matched it with IVgyg2. In another section we have already found that length has an influence upon color, when the discs are turned clockwise and reversed,

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[1] Discs which are made of plain sectors of black and white upon rotation become a uniform gray from center to circumference, but when the sectors are notched or toothed, the conditions are changed even though the proportions of the brightnesses are still equal. Sherrington, Jour. of Phys., XXI, 1897, 47, shows that these temporal relations also effect degree of flicker, and proves that the direction of rotation changes the time of persistence of flicker.

Contrast with the colors of the neighboring ring has a slight effect upon the color. Discs 13, 15, 19, and 21, which have all lines arranged so as to produce green, were described as "monotonous, unsatisfactory, unpleasant." The effect was often very slight, because the influencing colors are themselves often only weakly saturated. It was often difficult to distinguish the cause of saturation. Take, *e. g.*, discs 11 and 12: ring 2 in disc 12, with ring 3 red, was described as light olive, vivid and rich, olive with gray; ring 4, with ring 3 red, was described as deep olive, saturated but not pure green gray. Ring 4 of 12 had the advantage of position over and above the contrast common to the two; yet ring 2 of disc 11 was described as the more saturated, or at any rate as not less saturated than ring 4 of 12. Again in disc 17 green appeared on rings 1 and 3 with red on 2 and 4; B. reported 1 as pale green, 3 deeper than 1; H. described 1 as almost pure green, while 3 was not so deep; M., too, described 1 as dark and saturated, 3 as blue-green, lighter and thinner than 1. Here some of the individual differences appeared. Ring 3 for H. and M. was more apt to become violet than was the case with B., and the advantage of having red on either side could not overcome this tendency.

§ 8. CONTRAST: EFFECT OF GRAY SCREEN.

In order to study the effect of contrast gray screens were made; one of these is shown in Fig. 2 of the Plate.

The screen was a neutral gray paper on a stiff cardboard large enough to cover the disc. A small hole in the center fitted over the screw of the spindle, so that the card could be held back close to the disc,—so close as to avoid shadow, yet not close enough to interfere with the turning of the disc. There were seven screens, each with a semi-circular opening wide enough to expose one ring of the disc: four, of course, were needed for the four-ringed discs, and three for the three-ringed. Besides cutting out the remaining rings, the gray screen also cut out the surrounding bright field of the whole disc. (The experimenter often noticed that the colors were
brilliant when the lamp-light shone in the face.)

e general effect of this screen—excluding contrast both
ring and with field—was to *decrease* the brilliancy of the
of the ring. M. studied only a few discs in this way,
e few results obtained were remarkably uniform. The
s for the reverse of discs 9 and 11 are given as illustration.
remarked that rings 1 and 2 of disc 11 were different
seen together, 1 being darker and greener.

most extensive studies with the gray screen were made
B., O., and W. as observers. In all cases the rings were

TABLE III.

	DISC 9.			DISC 11.	
	No Screen.	Screen.		No Screen.	Screen.
Ring 1.	IV R	IV RRv1	1.	IIIyg1	IVyg4
" 2.	IIIgyg2	IVyyg4	2.	IIIyg3	IVyg4
" 3.	IIIyyg4	IVy4	3.	I BBv	IV BBv3
" 4.	III BBv	IV Bv2	4.	IV RRO1	III ORO2

reported on without the screen (these reports are not included in Table I), sometimes before the screen was put up, sometimes after, sometimes both.

In general the result is as noted above. O.'s results were most marked with respect to the greens. He was shown discs 5, 7, 8, 9, and 10. In all cases except disc 7 the green lines were reported "gray," without the screen "green." In disc 7 there was "a little green" with the screen, without the screen it was "greener." Rings on discs with colored sectors became "more saturated."

The most notable fact in B.'s results was that with the screen the blues were apt to be very green. In discs 1 and 10 the lines were black, in 5, 7, and 9 green-blue. The reds were least, and the greens most affected by the screen.

W. observed discs 1-25, and 30-33. The reds were least dulled or changed by the screen; the blues were less blue and bright; the greens were most changed, often losing entirely their faint green cast, and sometimes even the "red spots here and there." It was noted that toward the latter part of the investigation W. reported "no change" more often than during the first part.

More detailed investigations were made with discs 13, 15, 19 and 21. Since the rings are dulled or deadened by being all alike, it was thought that the screen might help to increase the saturation by relieving the monotony. But the effects of the two must be about equal, for the colors are the same with and without the screen. W. reported that disc 13 was greener without the screen; disc 15 showed no color difference but a brightness difference,—less bright with the screen; disc 19 showed no change, all rings were blue-gray with spots of red; disc 21 showed more red than 19; and W. noted that in ring 4 there was less *red* with the screen, if there was any change at all. Be., with disc 15, saw all lines as possibly green-gray with red here and there; the screen decreased the red. Contrast effect was manifested very slightly in the spaces, more often within the groups than between them. For O., B., and W. this influence was very slight, and (except occasionally with the blue, when the blue seemed to tint the spaces) they did not speak of it unless they were asked. For H. there was more color, but for M. there was most: she of her own accord reported the colors of the spaces just as systematically as of the lines themselves. The yellow of the white sector was apt to give its tint to the whole disc, especially at the outer edges. The reds had faintly green (blue-green, or yellow-green) in the spaces, the greens had reddish or lavender spaces, the blues seemed almost always to give their own color to the spaces. The blue was the strongest generally, but all of the tints were very nearly liminal.

§ 9. DAY-LIGHT AND DECREASE OF LAMP-LIGHT.

The experiments made in diffuse day-light can scarcely be compared with those made in artificial light, but they may serve to show the effect of increased light. All colors except the blue were faint. The reds were reported as brown, or blue-red; the greens as gray-greens, often there was not a trace of green; yellows were never reported by this name, but either as light gray-green or (more often) as light slate blue or lavender; the blues were rich, luminous, violet-blues,—richer than simple dark blue would be. The artificial light was not decreased by exact measurement, but changes were roughly estimated. The effects were studied with disc 1. When the light is turned only a little lower than that ordinarily used, ring 1 becomes *very* dark red, 2 a pinkish-yellow, 3 a black with maybe a tinge of red. Further decrease makes ring 2 the reddest. Again decreased, ring 1 becomes dark green, 2 a blue-green which turns to pink, 3 a very black-green; decreased still further, 1 is a very rich deep green, 2 a smoked pink, 3 red at first glance turning almost immediately to green. When the light is almost out, the color of ring 1 can scarcely be distinguished from that of ring 2, but after a few seconds 2 becomes a lighter pink, 3 is darkest of all and is greenish. When the light is turned constantly and gradually, the observer watching all the time, the first change is to a yellowish effect, then to a pinkish all over the disc. At this same moment the red (ring 1) changes almost instantly to green; the green a little later becomes yellower, then red, and at the same time the blue (ring 3) becomes a red purple. With further decrease, the green of ring 1 becomes a very deep red, and 3 becomes green (but when the observer comes very close to the disc it is seen to be a black-red). The whole disc, just before the [illegible] goes out, has a very dark, faintly reddish shade.

These [illegible] are at least roughly in accord with the Pur-[illegible]. With day-light the lines become bluer, [illegible] light they become redder or greener. These [illegible] in accord with those given in § 5.

§ 10. COLORED BACKGROUND.

After having ascertained that the color of the lines is conditioned by the alternation and duration of black and white stimuli, a series of discs was prepared on which the lines retained positions similar to those in the preceding series, but in which a portion or all of the white semicircle was replaced by a background of one or more colors. Almost from the outset there was evidence of a strong effect of simultaneous contrast. This continued so constantly and so similarly with the different observers that the Helmholtzian explanation was out of the question. Since a consciousness of the backgrounds is inessential for simultaneous contrast, we cannot hold that it is an instance of *Urtheilstäuschung*. We must hold with Hering[1] (as well as with Fechner[2]) that simultaneous contrast depends not only upon the stimulation of a certain part of the retina, but also upon the stimulation of the surrounding portions of the retina. Sherrington, at a much later date, emphasizes this same fact, and adds that this reciprocity is *subconscious* in origin yet affects consciousness.[3] The fact that the color of the lines depends upon co-excitation is more evident here than with the black and white discs. It was also noted in § 8, that the gray screen had a greater effect upon discs with colored backgrounds than with the plain ones.

The discs upon which appear only a single background color (sets I to V inclusive, and set XIII) are more instructive for the investigation of contrast effect than the remaining sets, because they avoid complications. For the sake of convenience, we shall continue to speak of the lines as red or green or blue in order to designate their positions, although as a matter of fact these colors under certain conditions are entirely lacking. For the sake of uniformity, the colors will be studied in the order of red, green, blue and yellow, as regards both sectors and lines.

A. When red lines appeared upon a red background the quality was entirely changed. If we remember that the complement of red is a bluish-green, and if we take into account the fact that for some of our observers green is very rarely present, we may say that *when red appears upon red the lines become complementary to the surrounding background.* When the white background was entirely replaced by red, in which case the fused background became very dark red, the complementary green was also very dark, rich and well saturated. On the other hand, if, *e. g.*, only one sector was replaced by the red, so that upon rotation the background was a light red, the lines became correspondingly light, and took on a light green-blue or blue-green that is difficult to classify. The observers were inclined to call it green-blue, but often remarked that they were not sure which color predominated. When the colors were matched they chose blues, very light, as, *e. g.*, Ib5. M. chose IIbbg2, but named it 'baby blue' even after she knew that green was present.

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[1] Hering: Lehre vom Lichtsinne, Pt. II, 1878, § 11. Also in Sitzungsb. d. kais. Akad. d. Wiss. Wien, 1872 and later.

[2] Fechner, G. T.: Pogg. Ann., *loc. cit.*

[3] Sherrington, C. S.: *op. cit.*, 38.

If, then, we leave these variations out of account, the red lines on the red background became the complement 36 times out of 39. O., in disc I 1, said the lines were slightly red, and W. reported gray once and black once. When red lines appeared upon a white sector, with red upon another, the result is practically as it is when there is no colored sector. Red was reported 28 times out of 29, green reported once (O.). When red lines appeared upon a green background, red was chosen 31 times out of 31. To be sure, the shades of red varied from a good red to a violet or dull rusty brown, but the descriptive word was always red. When red appeared upon white with blue in another sector, red was chosen 27 times, green twice, blue-green once, yellow once, and black once. The color was never pure, and there was almost invariably an unpleasant affective tone. Such adjectives as rusty, chocolate, brown, dull, unsaturated were used to modify the report 'red.' On the other hand when the red lines appeared upon white, with yellow in the background, red was reported 22 times, yellow once (B.), and this was a deeper, richer yellow than the ground. In every case the affective tone was pleasant. The colors were dainty, light yet pure, luminous, rich and brilliant.

B. When green lines appeared upon a green background, we found no such precise uniformity as with the red lines. Still, they may be said to follow the same law. When green lines appeared upon the green background, the complementary was chosen only 17 times out of 30; 9 times green was chosen, twice the lines changed almost immediately *from* green *to* red, and 3 times red and green were combined,—not fused, but appearing in different places upon the same line. Of the 9 times when green was reported, 5 concerned lines on disc 12, where the entire semicircle is green. In one other case *green* followed the nes. In 3 cases there were two sectors of green, but white llowed the sector upon which the lines appeared.

From this we may draw the conclusion that the green, which e found with the black and white discs to be very weak, is ot able to assert itself over and above the effect of the background color.

It should be noted that the green was very instable, that it was very apt to become lavender, or even decidedly red. When green lines appeared upon red they remained green. These rings were often compared with the red lines on the red (which we saw became green or blue), and the green lines were found to be *less* saturated than the red. The green was the same light blue-green. For O. and W. the lines were occasionally orange or red in gray. The green lines upon blue were reported 22 times as a bronze or a yellow-green shading toward orange or pink. But it was always an unsaturated color, matched either with plates IV or V, or with rows 5 or 6 of the chart. Green upon yellow was reported 26 times as very light blue-green or green-blue, 4 times as gray with flashes of green. When green appeared upon white, with red in the background, red was reported 29 times; with green in the background, green was reported 18 times, violet only twice; with blue in the background, 8 reported green (including gobelin blue), 5 said blue, 4 red, and 1 black,—the colors were usually dark; with yellow in the background, green shading to yellow was reported 29 times, twice a combination of red and green, the colors being usually light and unsaturated.

C. When blue lines appeared upon blue, we found again a law similar to that governing red. The reports varied from reddish-brown to VI OrO, a very dull orange, and were given thus 39 times; twice there was described a royal purple surpassing any color on the chart in saturation and luminosity. Usually the colors were very hard to match on account of their low degree of saturation, and were accompanied by an unpleasant affective tone. When blue lines appeared upon a red background they became a very rich, luminous blue-green. The reports I b 1, I b 5, IIbbg 3 show that they were very light and that there was a tendency toward green-blue. When blue lines appeared upon a green background they became a dull reddish-violet (VIIrrv) tending toward a dull orange. The complement of the background color added its effect to the lines with both green and red. When blue lines appeared upon a yellow background, the color of the lines and the contrast effect reinforced each other and a rich, navy or indigo blue resulted.

When blue lines appeared upon white, with red in the background, they became a deep rich red-violet, rv, or IV r; with green in the background, they became brighter, IV bv, I bv, or IV to VII bg; with blue in the background, the color of the lines was enhanced, and became a rich wine, or purple, or violet; with yellow in the background, the blues became greenish III bbg, III bg 5 or 6, III b, usually colors of a rather high degree of saturation.

D. Yellow lines upon yellow follow tendencies similar to those of green upon green. Blue was reported 5 times, blue-green twice, combinations of green and red twice, yellow-gray to yellow-green 14 times and gray twice. Yellow lines upon red became blue or blue green, very light and bright; upon green, a pale, dirty green when a white sector followed, but when a green followed the lines became orange or even purple; upon blue the lines were yellow, varying from a good yellow to a pink orange. When yellow lines appeared upon white, with red in the background, the lines became reddish, but more yellow if a white sector immediately followed the lines; with green in the background, the lines too became greener than usual, so that even W. saw quite clearly a tinge of faded green; with blue in the background, the lines became a deep indigo blue when blue followed immediately, but they became more reddish (rv) if white followed immediately; with yellow in the background the lines were a dull yellow, a sage green, occasionally tending to change to a reddish or bluish cast.

E. Where there are *2 colors* in the background, the lines are brightened or dulled according to the relation existing between line and color; *e. g.*, in discs VI 1-3 the red lines on red (2 red, 1 green sector) were such a dark red that there was scarcely any color for B. and H.; M. could see both red and green occasionally, which gave a gray effect; W. matched the lines with II bg. In VI 2 the red rings were still on red (2 red, 1 blue sector) but took on a very unsaturated blue-gray color for all,—only for an instant was it green for B. But in VI 3 the red ring became a dark and unsaturated green (2 red, 2 yellow sectors) for B., for H. a greenish-blue, for M. a light blue-green with occasionally the red and the yellow of the background coming over it, for W. a bright blue matching I b 1.

But when VI 1 was reversed, this threw the red over to ring 3 which was *on* green. This means that the red lines will be bright by contrast, and evidently this red is not dulled when the red sectors follow. B. reported II r, H. V r, and M. IV r with more red.

Ring 2 of this same series of discs showed also that, if the ring color was brought out by a complement, and was then followed by its own color, it was enhanced. VI 1 ring 2, green on red, with regular turning was followed by red. The report said that it was a beautiful, dainty green, apt to be bluish, a little lighter than grass-green, and W. matched it with III bg 2. But upon reversal both B. and M. chose IV gyg to match it, and H. IV yg. (This is quite dark, yellowish and unsaturated.)

Similar facts with other colors appear on other discs. XI 3 ring 4, *yellow* lines on *yellow* with *blue* following, was for B. on lines 2 and 4 blue, and on lines 1 and 3 brown, for H. green, for M. faintly yellow green, for W. vbv. Reverse of disc VIII 3 ring 2, *yellow* lines on *blue* with *blue* following, for B. was III yyg 4, for H. IV O 4, for M. II OyO.

VIII 3 ring 2, green lines on *blue*, yellow following, was for B. green, H. green, M. y-green, W. blue and red.

XI 3 ring 2, green lines on yellow, yellow following, was for B. navy blue, H. red-violet, M. black-red, W. dark red, III v.

VI 3 ring 2, green lines on *red*, yellow following, was for B. light green with some red, H. blue-gray, M. pale green-yellow, W. an unsaturated blue.

On all of these green has not the proper circumstances to bring out its color well. Contrast the above with the reports given for X 1 ring 3, green lines on *red*, green following; for B. green, lighter than grass-green, matched I gbg1; for H. slightly green-blue, matched II gbg 1 (and sometimes gyg); for M. saturated green, matched IV g; for W. I gbg 2. These colors were reported and matched on different days. The very striking similarity between reports cannot but be noted.

Analogous descriptions could be reported at tedious length, but these are sufficient to prove the point with which this part of our discussion began. The lines are brightened or dulled according to the relations existing between the color of the lines and the colors of the background, This serves to illustrate again the fact of contrast, which appeared in the preceding discussion. It shows, as did the preceding part, how very rapidly the different excitations produce their effects. and how infallibly certain sectors (which denote certain durations of stimulation) take on their own proper colors.

Our *general conclusion* from these detailed reports will then be as follows. 1. When the lines appear upon the background of their own color-quality, they take on the color complementary to the background.

2. When the lines appear upon a white background, with a color in the background, they have practically the same color-quality that they have when the disc is plain black and white, but they are affected by a colored background according to the laws of color mixture. That is, when the color of the lines is complementary to that of the background, the color of the lines becomes duller as a result of the mixture; but when the color of the lines is related to that of the background as a neighboring spectral color, then the color of the lines becomes a mixture of the two,—brighter or duller according to the qualities of the colors mixed.

V. THEORY.

There are, without doubt, numerous other ways in which the phenomena of Fechner's Colors might be brought about, and there are many other ways in which the discs might be varied. But the important point is to discover the conditions upon which the colors are dependent; as a corollary to this followed the investigation of the conditions which served to bring out the colors in the best way possible, to produce the greatest possible saturation and purity of colors. The use of fine lines upon a white background is much better for the production of clear-cut colored areas than the use of large blocks of black and white, and better than cutting out sectors from either black or white discs. Both of these methods give larger masses of color, but the extent of colored surface can be determined with less accuracy, and variations can be made less readily. Further variations, but also greater complications, could be obtained by the use of a greater number of colored backgrounds and by the use of colored lights.

Our aim has been to avoid such complications as might lead to confusion of results, and thus obscure any law which might appear with greater simplicity of conditions. It is under very simple conditions, then, that we have obtained the preceding facts.

The phenomena of the discs cannot be disputed. Given the conditions of illumination, rate and construction of the disc as described, one can predict infallibly the general color tone which will result for the normal eye. There can even be predicted the result for the fatigued eye But this is only to state the problem, not to solve it. A theory must state the special conditions upon which the appearance of a quality in consciousness is dependent, and these conditions must necessarily be sought in specific bodily dispositions and functions. Hence we have turned to the theory of vision proposed by Ebbinghaus, because it brings us nearer to these bodily dispositions and functions than any other theory yet advanced.

The theory of fatigue must be abandoned, for the colors take on their greatest saturation at about the time required for perfect accommodation (upon the disc, not the lines), and *lose* their saturation as dissimilation continues. We cannot agree with Helmholtz that a certain amount of fatigue is necessary for the perception of the colors. The theory that the colors are due to sympathetic excitation must also be put aside. Red may be due to some extent to this cause; but there surely is no reason to think that sympathetic excitation would act in such a way with one set of lines, while the one following next to it gives the very opposite color. Hence another explanation must be sought for the three remaining rings of the disc. If a satisfactory account can be given of these, there is no reason why red should not be explained in a similar way, instead of being set aside by itself as due to some peculiar disposition.

The theory that the colors are complements causing each other must be given up for the reason that it, too, cannot consistently be carried through for all colors. At first thought it may seem reasonable to explain green as being the complement of the red, but the weakness of the explanation appears when we compare the brilliancy of the green with the brilliancy of the red, and note the time of excitation which precedes the appearance of green. Even allowing that the green-yellow of the following ring may result from the same cause, we are not able to account for the brilliant, luminous blue which appears in the fourth ring. The theory of irradiation has already been given up. Contrast must also be discarded as an ultimate cause, although (as has been shown) it plays its part in the phenomena.

One naturally looks to one's facts as reinforcing or making against some existing theory of visual sensation. Unsystematic work with the discs might easily lead to the conclusion that the results would furnish verification of the Helmholtz theory; but further work would inevitablv lead one to abandon a three-color theory. In our own work it looked for some time as if there were only three colors present, even with the four-ringed discs. But the fact that the third ring (Fig. 1) changed so often to a blue-gray or stone-blue led us to believe that the excitation caused by it was of a nature different from that caused by the second ring, or concerned a different visual substance. The fact that when for any reason ring 3 grew lighter it grew yellower, led us then to believe that it was the amount of black that was obscuring the yellow: hence the series of discs was made which has already been discussed in IV § 3. When this difficulty was obviated, it was evident that the reaction to this ring was yellow. This fact was further borne out by the experiments with the colored backgrounds (IV § 9). We then turned to an examination of the four-color theories, and after a consideration of them finally selected Ebbinghaus's modification of Hering's theory as that which furnishes the most adequate, the most detailed and the most concrete explanation of the experimental results.[1]

This theory was chosen with an understanding of its uncertainties, and of the criticisms which have been passed upon it.[1] Ebbinghaus himself accepts the Hering theory, with the reserve to which one is forced by our lack of knowledge of the physiological processes of the retina, but accepts it because it is at least typical of the processes which must be present. In the same spirit, then, in which Ebbinghaus accepts the theory of Hering, we here accept the theory of Ebbinghaus. It is a mode of representation of the facts which we have obtained. Thus we set to work with our eyes open, as it were, understanding our limitations.

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[1] Ebbinghaus, H.: Zeit. f. Psy. u. Phys. d. Sinnesorg., V, 1893, 145-238. This article gives more detail than the account in the *Grundzüge der Psychologie*, 1897, 169-263.

According to the Ebbinghaus theory, normal color-vision is mediated by three substances that are sensitive to light. One of these, the white substance, is spread over the entire retina. It absorbs the light-rays of almost the entire visible spectrum, and this absorbed light serves to decompose it. The energy thus set free is in a form suitable for the excitation of nerves, and the result of this stimulation appears in consciousness as a sensation of brightness.

A second substance, which is found in the layer of rods and cones, and which does not extend over the entire retina, is identical with the visual-purple. It absorbs preferably the yellow rays. The decomposition-product formed by this absorption in its turn forms the visual-yellow. This visual-yellow absorbs the blue rays, forming a decomposition-product which gives rise to the visual-purple again.

A third substance, which is found in the cones and which thus covers a more limited area of the retina than either of the other substances, is called the red-green substance. Originally it is colored green and absorbs the red rays. The decomposition-product resulting from this absorption forms the red substance which absorbs green.

Thus in both chromatic substances there is a circular movement, a continual change of the one substance into the other. No substance is ever entirely exhausted. This color rhythm is always accompanied by the excitation of the white substance, by which energy is set free.

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[1] Kœnig, A.: Sitzungsb. d. Akad. d. Wiss. zu Berlin, 1894, part II, 577-598, *Der menschliche Sehpurpur und seine Bedeutung für das Sehen.* Kœnig agrees with Ebbinghaus regarding the change of visual-purple into the visual-yellow which gives the sensation of blue (591). But he says that the still unknown visual substances which mediate the sensations of green and red (as well as the visual-yellow) are decomposed with more difficulty than the visual-purple (591). The results obtained from our discs disagree with this second statement.

Other important refences are: Kœnig, A.: Zeit. f. Psy. u. Phys. d. Sinnesorgane, IV, 1893-4, 241; von. Kries, J.: same Zeit., XIX, 1899, 175; von. Kries, J.: same Zeit., IX, 1895-6, 81; Hering and Hess: Pflüg. Arch. (Arch. für die ges. Phys.), LXXI, 1898, 105; Kuehne, W.: Hermann's Hd-bh. d. Phys., III, part III, chaps. 1 and 3.

Ebbinghaus differs from Hering in giving to all these changes, which are the immediate conditions of sensation, the name of dissimilation processes. He gives them all the same name because he believes that their modes of excitation are not essentially different.[1] Stimulation by one color excites all the visual-substances. Ebbinghaus objects to naming one part of the result of stimulation assimilation, and the other part dissimilation. Hence it follows that the excitation curves of complementary colors are not entirely antagonistic but partially coincide. Ebbinghaus believes that this simultaneity will explain the action of complements better than will Hering's theory that the one color blots out the other. These are the main points of divergence between the two theories.[2] Ebbinghaus attempts to bring the psychical facts into more specific relations to physiological substrates, and to give the colors a more definite temporal relation.

According to the Ebbinghaus theory, after the eye has been in a state of rest it is in a condition to have the sensation of yellow: *i. e.*, there is then a comparatively great amount of visual-purple, dissimilation of which gives rise the sensation of yellow.[3] The decomposition-product of visual-purple gives rise to the visual-yellow, by excitation of which there is produced the sensation of blue. Regeneration of the visual-yellow in turn gives a greater amount of visual-purple, which is again ready to be decomposed. Regeneration does not take place so rapidly as decomposition, and the rhythm proceeds more slowly as decomposition continues.

Ebbinghaus notes the discovery by Kuehne of the inertia of the visual-yellow,—that it often persists for hours before becoming colorless.[4] This means a heaping-up of the yellow substance, and it in turn reacts upon the visual-purple. If the visual-yellow is decomposed slowly, then the visual-purple is regenerated slowly because material is lacking. It cannot be entirely exhausted, for the visual-yellow is being spontaneously decomposed.

Kuehne experimented with the frog's retina, and found that ten minutes exposure to strong sun-light is necessary to bleach the visual-purple, and that regeneration requires from 1 to 2 hours. The rate of bleaching is much more rapid in warm-blooded animals,—sixty times more rapid than in the frog.[5]

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[1] Ebbinghaus: *op. cit.*, 185, 195–6.

[2] Christine Ladd Franklin, at an earlier date (Proc. Internal Congress Exp. Psy., London, 1892), published the same criticisms of the Hering theory. Also in Mind, N. S. II, 1893, 473; Science, XXII, 1893, 135.

[3] Ebbinghaus: *op cit.*, 202.

[4] Kuehne, W.: Hermann's Hd-bh., III, 1, 278, 287; I, 432.

[5] Also in Schaefer's Text-book of Physiol.; II, 1900, 1045.

These facts, or at least facts analogous to them, accord with the phenomena of the discs. The yellow was apt to turn blue after short periods of observation, while the blue persisted practically unchanged during long periods.

This theory of Ebbinghaus's corresponds entirely with the results obtained from our discs. Upon rotation it is ring 3 (Fig. 1) which gives rise to the sensation of yellow; *i. e.*, there is a relatively *short* white-stimulation which is suddenly cut off by black-stimulation. It is ring 4 which gives rise to the sensation of blue; *i. e.*, there is a relatively *longer* white-stimulation which is suddenly cut off by black-stimulation. This must mean, then, that the duration of stimulation is sufficient for enough of the visual-purple to be dissimilated, which dissimilation-product forms visual-yellow, excitation of which gives rise to the sensation of blue. This fact may also give us some idea of the time required for generation of visual-yellow, over and above that already present during a condition of rest, which is sufficient to give rise to the sensation of blue. This theory is further borne out by the fact that if the eye is in a state of fatigue, so that in ring 3 the eye is scarcely renewed at all by the rest, the lines which should give rise to yellow pass over into blue. H. was especially liable to such fatigue. In disc 15 (all lines in sector 3) H. saw ring 1 as violet; in disc 19 H. saw all rings as rv, and to W. they were blue-gray, while to B., M., and O. they were yg. In disc 20, where the lines were longer, B., H., M., O. and W. saw all rings as bluish. The case is similar with regard to red and green. It is ring 1 (Fig. 1) which gives us the sensation of red; *i. e.*, there is a sudden excitation which is continued. It is ring 2 which gives us the sensation of green; *i. e.*, there is white-excitation which is suddenly cut off by black excitation, there is then another white-excitation which is again suddenly cut off. If the eye is fatigued, so that the passing of the lines gives insufficient time for regeneration, the green becomes mottled with red. With W., who almost never saw green, the *gray* almost invariably has spots of red "here and there."

All the facts of the disc correspond with the Hering theory. dissimilation colors, the yellow and the red which irst, and the assimilation colors, the blue and the ch appear second.[1]

postulate some substance, or a series of substances, elongs a definite temporal reaction to white light. re are no substances which correspond exactly to the theory of Ebbinghaus, the theory which he has advanced may be said to be typical of what the true theory must express when the proper physiological substrates are discovered. We may even go a step further than Ebbinghaus and make the postulate that the dissimilation of red and green takes place before the dissimilation of yellow and blue. Thus we have the complete temporal series red, green, yellow, blue.

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[1] poral series red, green, blue obtained with the disc is in ith the series obtained by Kunkel (Pfl. Arch., IX, 1874, *equate* stimuli reduced to equal intensities.

To summarize: color sensations which have definite temporal relations to each other may be produced by the rapid alternation of black and white sectors. The colors are further dependent upon the duration of stimulation, and the co-excitation of black and white. They are also dependent in less degree upon length and width of lines; upon their position within the sector; and, as are all other subjective states, upon bodily conditions, practice, fatigue, and attention. These conditions are necessary for the production of color itself; but after it is once present its quality may be changed by change in rotation of the disc, change in amount of light, and by addition of background color. All the phenomena find a satisfactory explanation in terms of a four-component color theory.

ERRATA.

P. 496 read:
  II—5. Red, 4. Green, 3. Yellow, 2. Blue, 1 (yellow)
  III—7. Red, 4. Green, 3 (yellow) Yellow, 2 (yellow) Blue, 1
P. 497 read:
  X—1. Red, 1 (green) Green, 3 (red) Blue, 2 (green)
  XIII—2. Red, 2 Blue, 3 (red)
P. 510, line 4 read:
  Purkinje phenomenon with the light-adapted eye: see Hering, Arch. f. d. ges. Physiol., lx, 1895, 519.
P. 511. First line of Table, for VgBg read Vgyg.

A PRELIMINARY STUDY OF THE BEHAVIOR OF MENTAL IMAGES.

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Most of the treatises on the topic of imagery have been grounded on the isolation and classification of the material, and have possessed all the advantages and disadvantages of this method. The facts comprised in the term mental or associational type are a contribution of the very greatest importance. To determine the special sense channel in which a subject's mental processes tend to flow is now a recognized prerequisite to psychological work, since it gives a constant known quantity, so to speak, in the estimation of all results obtained from him. The chief criticism to which the method is liable is that its conclusions are based on mass results, hence too general and lacking in that concreteness which the subject of images can justifiably demand.

The present study[1] is an attempt to supplement the classificatory results by an examination of particular images, if not in their functional relations, at least *in situ*. It was our desire at first to make an exact register of the behavior of the image as regards the time intervals of clearness, indistinctness, disappearance, etc., and in this way obtain an index of its persistence in consciousness. We soon found it impossible, however, to make such a record, as the slightest attention given by the subject to the work of registration, even with the most delicate instruments, resulted in the immediate and permanent loss of the image. Actual trial proved the method not only impossible but also undesirable as the changes in the appearance of the image were found to depend upon a set of circumstances quite as important as the changes themselves and entirely too complex and variable to reduce to exactitude. So it was thought that the accumulation and comparison of introspective results, obtained under test conditions, would afford the best means of approaching the image in its actual relations. This, of course, required subjects who were exceptionally well trained in methods of introspection. As to type, one was strongly visual, another auditory-motor, and a third visual-motor, so that there was sufficient diversity to keep the conclusions from the error of being based on one-sided results. All of them had had several years of training in psychological work, and were used only after trial had demonstrated their expertness in introspection. Incidentally, it is surprising how many supposedly well trained experimentalists are found deficient in this requirement, and the insistence by Professor Titchener upon the fact that the experiment is only an arrangement of conditions to assist the introspection, may be considered most timely.

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[1] This investigation was undertaken at the suggestion of Dr. Sanford, and part of the work was carried on with his assistance.

The method was to ascertain as nearly as possible the exact behavior of the image during a certain interval of time, which after trial was fixed at ten seconds.

VISUAL IMAGES.

Visual images are by far the clearest and most independent, and in consequence, have offered the most fruitful field for the investigation of the general subject. For the study of related problems, like those of memory and association, that material would naturally be chosen which was least involved with other factors, and which would show in the most direct way the result to be attained. The consequence is that images from other sense departments have been largely ignored in the literature, and relatively too much prominence given to those of a visual nature. Fechner's description[1] of his own visual images is given solely for the purpose of distinguishing them from after images, but is, notwithstanding, the best account of their characteristics yet presented. The chief distinctions, he tells us, between after images, on the one hand, and memory and fancy images, on the other, are that the former appear only with a feeling of receptivity, in connection with a certain sense impression, and independently of voluntary effort and association of ideas; and depart, also, relatively to the immediately preceding sense impression, and independently of voluntary effort. Memory and fancy images arise with a feeling of greater or less spontaneity, a longer time after the preceding sense impression, partly involuntarily through the association of ideas, partly voluntarily, and can be varied and banished in the same way. He describes his memory and fancy images further as seeming to lack corporeality, as washed out and indefinite. He cannot obtain clear sharp boundaries and can produce only the most familiar memory images of objects that are daily before his eyes. He cannot hold the memory image more than a short while. It must be renewed if observed longer. If he tries repeatedly to call it up, the attention or production activity becomes blunted. This is not at all a blunting of recall (memory activity), since he is not hindered from calling up another memory image just as clear, and when the attention goes back to the first image, it can be produced with original clearness. This holds of closely related images, as two figures in the same photograph, or two portraits in the same room. If these are used too continuously, the attention blunts for both, but can turn to a third and back again in the same way. In no case can he place objects in the memory field in other relations to each other than as corresponding to the forms of actual observation, and his fancy cannot operate with its creations outside these limits. Thus he cannot represent a man full face and in profile at the same time. Another result is that he can succeed more easily in arousing memory images with open than with closed eyes. The field is more limited but still relatively clearer. To do this he must entirely withdraw the attention from without, and can succeed better when the eyes are turned toward the floor. It is as if with complete closing of the eyes, the lightstuff, of which the images are woven, is lacking; as if the dark field is more disturbing for its perception than the soft daylight. Memory images, unlike after images, are possessed of perspective, and can be made to appear in any direction desired. He can pass from one memory image to another quickly, almost simultaneously, with a feeling of continuity; can also pass from after image to memory image quickly, but the continuity is broken. The attention must be abstracted from the after image in order to get the memory image. The only reference he makes to the relation of images in the different sense departments is that when we pass from one to the other, there is a definite, not to be described but easily reproduced, *feeling* of the changed direction, which we can liken to a differently localized tension, as from eye to ear.

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[1] Elemente der Psychophysik, II, p. 469 ff; 1889.

Reference has been made to Fechner's work at length because it is the nearest approach in the literature to the object of the present study. Galton's chapter on "Mental Imagery"[1] is chiefly of a statistical and descriptive nature. He considers the question of visualization from the point of view of its prevalence, and finds it generally deficient with men of science, strong with artists, vivid with children and primitive peoples, and varying somewhat with nationality. The work, while of the greatest value in a general way, can hardly be relied upon in its discussion of particular points, and shows throughout the deficiency of not having subjected its material to exact experimental conditions.

Among later works may be mentioned those of Lay[2] and

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[1] Inquiries into Human Faculty.

[2] Psych. Rev. Mon. Sup. VII: Mental Imagery.

Bentley.[1] The former is almost entirely a study of types, based upon results obtained from students, artists and himself. The latter is an investigation of the visual memory image with reference to its qualitative fidelity and the effect of varying intervals of time upon it. The materials considered are brightnesses and colors, and the work is of great value from the standpoint of both method and results. It suffers only from the exceedingly limited range of its experimentation. There is included a most suggestive section on the genetic function of the memory image.

We have used the terms *mental image* and *memory image* as referring to the same set of phenomena, and perhaps it is necessary to justify this procedure by explaining in what sense they are interchangeable. Memory image has come to mean, specifically, one in which is reproduced with more or less completeness the original observation, with all the factors necessary to make it determinate. It is a process in which recall and recognition play an important part. The meaning of mental image is not very definitely fixed by usage, but with some the term characterizes that large group of images whose location in space and time has been lost. The question is chiefly one of familiarity. We do not call the image aroused by the word *horse* a memory image, because horses have been seen under so many sets of circumstances that no one stands out in particular. It is valuable for some purposes to preserve this distinction, but it really rests on a superficial analysis. The word *horse* is, in ordinary usage, little more than a word, and if any image is aroused, it is in most cases general, shadowy, symbolic and of only an instant's duration. If it is required that a definite image be produced and held when the word is called, it will be found that a very definite associative complex will come up in connection with it. This is either a particular situation from past experience or a composite of such situations. If the name of a certain building with which the subject is familiar, is called, the resulting memory image has reference, not necessarily to a particular occasion of observation, but to many such occasions, and is, really, in its turn, a composite. So the mental image is hardly one in which particular reference is lost, but in which the possibility of particular reference is manifold. So under the conditions of our experiments, which necessitated in every case the production of a definite image, it would serve no purpose to keep the distinction rigid.

In the following tests, with the exception of the card series, drawn figures were used instead of call words. The purpose in this was to keep the associative complex as much as possible under control. The subject was permitted to look at the figure for some time before the "ready" signal was given, at which he closed his eyes. Five seconds were allowed to elapse between the "ready" and the "now" which marked the beginning of the ten seconds interval, in order that the after image and the memory after image might pass away. A second "now" was used to close the interval, and the introspection was taken as quickly as possible.

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[1] *Am. J. Psych.*, XI, 1: The Memory Image.

(1) *Small black square on white card.*

St. Could not get it in several trials. Some figure would form around it and when he tried to drive it away whole thing would go.

K. Was able to see the black square; seemed to be hollowed out on two of the sides. Then movement of the attention from the square to the four corners of the card. Gray lines came in as diagonals and gave the whole card the appearance of a pyramid truncated at the square. Then came a blank period of about two seconds. Image was vague during remainder of period and only came out in flashes.

(2) *Black square in larger square.*

St. Could get only one side in. Others seemed to be there but not distinct. Spot quite clear.

K. Lines of outer square came first, with blotches or knobs in the corners; lasted about three seconds; very bright and distinct; central square entirely absent except for the vague feel of something there. Then went to square in center and imaged figure as a whole. Not distorted except for the corner spots. Did not notice outline of card.

(3) *Black and two surrounding squares.*

K. Saw outside square first; light yellowish; corners prominent again; lasted about a second. Then started on next square and got the two together. Middle spot still left out; did not appear distinct at any time. Figure did not hang together as one image. After about five seconds whole thing very vague. Corner knobs came on only the outside square; otherwise form not distorted.

(4) *Squares with diagonals added.*

St. Squares much more prominent than spot; two diagonals most distinct. Time of distinctness much greater than time of indistinctness; change very gradual; did not disappear at any time.

K. Whole thing vague. Started on outside lines; vague notion of lines inside; no perspective. Then got feeling of motion in figure [illegible] k and forth. Then black square in center came out very [illegible] vague perspective as looking into hollow. Lines still [illegible] lines of hollow not clear but black spot remained so.

[illegible] series seems to warrant these suggestions and

[illegible] matter of the greatest difficulty to get and hold [illegible] image like that of a small black square. Neither [illegible] ret it alone in repeated trials. An easy form of [illegible] t is to place a white dot on a large blackboard, [illegible] ng at it, close the eyes and try to hold it for [illegible]. It will be found impossible in most cases. [illegible] ads us to conclude that a certain degree of complexity is necessary in order to make an image continuous. This has an illustration in the second test where subject St could get only one side of the surrounding square, but this was sufficient to make the spot quite clear. A result that was entirely unexpected was the tendency of both subjects in the first test to supplement the lack of complexity in the figure by adding a subjectively created means of holding it. With St, this consisted of surrounding lines, and with K, of diagonals leading from the square to the four corners of the card, and throwing the whole into the perspective of a pyramid truncated at the square. Another interesting fact came out in the blackboard experiment. An image of the whole board would first be obtained, and immediately afterward the image of the dot would flash out clearly for an instant. While this was happening, however, the outline of the board would disappear completely. It would seem as if the image itself could produce a memory after image of position, which would persist for a moment after the disappearance of the image. Examination of any of our complex memory images will show that what seems to be an entire picture is really a matter of successive parts, a residue of position running from each into the next so as to give the feeling that they are presented simultaneously.

(3) The tendency to emphasize angles, as seen in the knobs which K placed at the corner of the square, and diagonals which with St took precedence of the rest of the figure, will be discussed later under the schematism of the image.

(4) The last two tests are remarkable for the diversity of results. When the figure was made more complex by the addition of another square, neither subject could hold the image complete but broke it into parts. K says definitely that it did not hang together as one figure. With St, when the diagonals were added, it became very difficult to get the spot. The opposite was true of K who threw the whole figure into pyramid perspective in which the lines were very vague but the spot very clear. It seems that here we have an indication of the limits of complexity in a plane figure which it is desired to hold as one image. If true, the range from minimum to maximum complexity is a very narrow one. It is, at any rate, evident from these tests that the clearest and most persistent images are those in which the spot stands in close relation to only a line or an angle. The probable difference between this and greater complexity is that the latter requires more time for the play of attention, and in this way the continuity in the perception is broken. The sense of perceptive which K had in the last test seems to be a means of subsuming a complex setting into a simpler one.

(1) *Semicircle.*

St. Able to get it easily, but when tried to hold without losing, brought on a sort of quivering. Direction and size as shown. Clear about two-thirds of time. No tendency to eye movement noticed.

K. Started on left-hand end of image and went around circumference. Figure distorted by bulging out in left quadrant. Slight stop at that point then rest of the way around. Saw the figure complete after about two seconds; then lost; afterward returned as whole for an instant. Did not notice eye movement.

(2) *Circle.*

St. More fluctuation than in semi-circle between distinctness and indistinctness; much harder to hold. Not all parts clear at same time. When made circumference object of attention, decided tendency to move eyes around. If on center, no tendency to eye movement, but circumference not clear in all parts. Attention moves either across or around. Some tendency to distort by making vertical diameter longer. Fluctuations about a second long.

K. Noticed center point first; then went to left and around. Seemed to get the circumference in pulses. Then got all parts equally distinct but lost center. Figure distorted by becoming smaller and larger. Several blank spells.

(3) *Circle with crossed diameters.*

St. Upper left and lower right segments only ones that came out, so that figure took hour-glass form. No tendency to eye movement.

K. Upper right and lower left sectors came out; really saw spaces without noticing lines. Other two were added on but looked darker. Then let rest go and tried to see circumference; got upper left segment. Then finally got circle complete with indistinct contents; lost idea of being cut up in parts.

(1) The first result of importance in this series is that curved lines are harder to hold than straight ones. The semicircle could be held complete, though only for a short time, which is undoubtedly due to the straight line forming the diameter. The circle was much more subject to fluctuations, and only a part could be held at one time. The result obtained from St in the circle test is typical of the way in which curved lines are imaged. If attention is given to the center in order to get the whole figure, the circumference becomes indistinct. If the circumference is brought out clearly, it comes in sections following the movement of the eyes which is very perceptible. This latter fact gives a clue to the difficulty, in holding a circle as compared with a straight line. The eyes seem to move easily in following a line even of considerable length, and with much greater difficulty in following a curved line. If the movement is not exact and well-controlled, the result is a distortion of the figure, as in all of K's images of circles. It may be that this difference in the ease of eye movement is carried over into a difference of ease in holding the image.

(2) In the final test, the result is the same with both subjects. The crossed diameters are so prominent in the image that

they shut out the circumference almost entirely by arresting the necessary eye movement. The greater clearness of opposite rather than adjacent spaces, is a fact that comes out in all experiments involving crossed lines. Both this and the joining of the ends by opposite segments is probably due to the attempt to follow out both lines at the same time. This is certainly true with the writer, who finds in addition, that the angle subtended by these segments constantly tends to grow smaller and the lines to run together.

(1) *Blank playing cards.*

St. First was of indefinite white background. Changed into ace of spades; not very distinct. Card was out in front, against gray background; position oblique.

Sr. White background; white card cut off from background by black lines. Black lines became indistinct about three times. By end of period had gone completely.

(2) *Ace of hearts.*

St. White background back of ace and some distance from it. Other images tried to crowd in. Fairly clear ace, a little larger than real. Card some clearer than blank.

Sr. Got card in oblique position on wall; heart in middle. First, a confused red, then changed to ace of spades, then came out clear red. The spade was small and ordinary size, not large and elaborate, and pointed down like the heart. Clear at end of period.

(3) *King of hearts.*

St. Fairly distinct, but kept oscillating. No outline to card; only heart and king visible. King seemed pretty clear; color same as real.

Sr. Confused at first. Card straight: king double with sceptre, might have been the knave, not the queen. No heart visible. Figure darkened and grew confused toward the end.

(4) *Straight flush from ace of hearts.*

St. Could see about two at a time in row: rest mere outline of hand. Passed down the row in this way.

Sr. After a time of confusion saw them spread out with ace at left and others in order. Ace was clear and remained so all through. Picture cards confused and could not be distinguished, Nothing definite about the others; shaded off into darkness; even the number could not certainly be fixed. Still trying to get the other cards, starting from ace which remained clear, when time ended. Colors in picture cards fairly clear.

The facts shown in the first two tests are the production of the blank card by cutting off a part of the gray background with black lines, and the tendency of closely related images to crowd in. This is one of the very few instances in these experiments where an antagonism of images was apparent, and here it is along a natural path of association. The third test shows that where a figure of great complexity stands in conjunction with another of little complexity, the latter is liable to be entirely neglected. With St, the outline of the card was lost, and with Sr, the heart did not come in. The image of the straight flush affords a good study in the relation of extent and detail. St could hold the outline of the hand and pass along it seeing two cards at the time. Sr could hold the outline and ace clearly, but the rest remained confused.

(1) *Letter A.*

St. Had some trouble in getting it. Hard to hold. Could not get natural size, seemed much larger. White spaces clearer than lines. Black was grayish. Was not defined clearly as letter, openings were too large.

St. More nearly natural size. Fluctuation in clearness very rapid; caught himself moving head in sort of rhythm corresponding to clearness. Did not repeat letter verbally. Noticed no tendency to run to other images during fall in clearness.

K. At first quite clear cut image as it is with white center left out; lasted about two seconds; broken by negative after image. Then again more distinct of letter with white space; better defined than before; lasted through.

(2) *Letter A in "ATE."*

St. Succeeded in getting A more prominent than TE. TE kept coming in, and oscillated much in intensity. Attention ran from A to TE then back; seemed rhythmic. Caught self repeating A-T-E over and over.

St. Much the same as before. Noticed in addition movement of eyes when TE came. Tendency to repeat letters very distinct. Dropped into indistinctness but for no appreciable time.

K. First a somewhat indistinct image of letter A; then T a little more distinct; E rather vague. Then back to A and got a very clear image of it. Articulatory of T; E remained indistinct. Then tried to get whole word visually; A distinct and other not. At last dropped into mere articulation of A-T-E.

(3) *Letter A in "RELATE."*

St. Conspicuous thing was inability to get A alone for any length of time. RE was indistinct for awhile then was most distinct. L did not appear at all. A did not disappear completely at any time. Tendency to run over letters but not to speak word. After other letters came up distinctly, attention always ran back to A.

K. Very vague visual of space that word takes, letters indistinct. Started to articulate; word broken in this way into two parts REL-ATE. Visual came again and followed the division. Got R very distinctly, other two vaguely; same when went to last part. [illegible] whole less distinct than motor.

[illegible] r tests are in some respects the most interesting [illegible] series, because they show the visual in connection [illegible] ry-motor elements, a combination rendered un-[illegible] ong association.

[illegible] ngle letter appeared as a purely visual image, [illegible] cy to articulate, hard to get and hold, and much [illegible] tuation and distortion.

[illegible] second test, St found the attention running from [illegible] ined prominent to TE, and back again in the rhythm set by the articulatory process. In the final test, K broke the word into two parts by articulation and then visualized it as broken, with the first letter in each part more prominent than the others. We have here a clear case of the visual following upon and being determined by the articulatory.

(3) It is to be noticed further that the A becomes clearer and can be held with less difficulty when articulated and placed in conjunction with the other letters. This latter process of reinforcement is probably the same as was found in the square series, where a slight complexity was necessary to give the attention play and also hold it within certain limits. The repeated articulation makes a direct and regular path back to the letter.

EXTENT AND SCHEMATISM OF THE INNER VISUAL FIELD.

The apparatus for experimenting upon this subject consisted of a black cardboard, two feet square, on which were pasted in regular arrangement five rows of five red spots, each an inch and a half in diameter. The subjects were not placed under time conditions, but were allowed to look at the board whenever they wished, and after closing the eyes, to continue as long as the image could be held easily. The introspection, as usual, was taken in full immediately. There is complete uniformity of results with all the subjects tested.

(1) When the effort is made to get an image of the whole figure, two indistinct rows come out, one on top, the other on the side. These consist merely of dark broad lines in which the individual spots are not defined. The rest of the board is confused.

(2) The easiest and most persistent arrangement of the whole board is that of two squares, an inner and outer, with the center left out. This again consists merely of the dark lines which sometimes look like indefinite beaded lines. If the attempt is made to bring out any particular spot, the squares break up and disappear.

(3) If attention is given to the central spot, isolated from the rest, it is hard to get, comes out only in flashes, and does not keep its position, but tends to stand out from the board or run over it.

(4) If the top row is taken and followed across, the spots can be brought out successively but only momentarily. The end ones come out most clearly and remain longest, the inner ones darken and are harder to get. The row tends after a time to go into a jumble, but can be rearranged by stopping and catching the end spots. Order is kept by counting. Dark lines run down from each spot to represent the vertical rows.

(5) The maximum number of spots that can be held clearly

at one time is five. These arrange themselves in certain geometrical figures, as follows: (a) Four corner spots of outer square with vague center in the arrangement of diagonals. (b) Center and middle outside ones in the arrangement of horizontal and vertical crossed lines. (c) Center and corners of inner square. (d) Center and middle ones of inner square.

Two of the facts noted suggest a resemblance of the inner field to the range of attention with minimum time of perception. These are the geometrical arrangement of five spots, and the prominence of the ends when a row is taken. There is, however, an important difference in the matter of extent, in that the attention during its single pulse does not select the number perceived from a larger number. Like minimum external perception, again, a basis is laid in its one act for the perception of more complex images. The most important factor, probably, in the constitution of the inner visual field, is the dropping of certain parts into obscurity, without losing them as a setting for the parts that remain distinct. Introspection fails to disclose fully just what takes place. There is a vague "feeling of something there," together with a certainty of what it is, and of the ability to recover it if wanted. It is probable that most of the setting can reduce itself to a highly abstract, even geometrical, schema of directions and positions. When attention was given to the red spot in a corner of the board, it could be held firmly as to position by reason of the right angle formed by the edges, so that the appearance of the rest of the card could be easily studied. For one subject, there were two broad lines leading off at right angles from the spot held, representing the two outside rows of spots, while all the remaining spots formed an undifferentiated mass, characterized only by a slightly brighter illumination. For another subject, a better visualizer, the outside lines leading to the spot were clear, and also the two sides of the inner square parallel to these, the broad gray lines being the nearest approach to distinctness.

Binet gives an interesting discussion[1] of the visual memory of chess players, and their visualization during blindfold games. One of the questions which he addressed to the players
d the extent of the image: "Do you represent to
the chess board and its pieces all together simulta-
only by parts which appear to you in a successive
A single player, Tarrasch, affirms that he visualizes
ntire, and that that total visualization is necessary.
ne adds that he represents a small board in order
ntal regard may be able to pass more easily from

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gie des Grands Calculateurs, 1894. p. 28 ff.

one space to another, it is very evident says Binet, that his visualization is successive. Another player, Schallop, says, "There are occasions when I see the board entire, but there are also others when I see clearly only that part of the board on which the combat is actually going on." "That last part of the response," says Binet, "states the opinion of the majority of the players. It is a rule, one may say, that players represent only a part of the board."

In a chapter on concrete and abstract visual memory,[1] there is presented an examination of the kind of image held in blindfold play. With some, he found visualization almost entirely lacking, the play taking the form of a mathematical calculation. With others who were in the habit of visualizing the board and pieces, all unnecessary details were dropped out and the image made as abstract as possible. One did not even distinguish the pieces except by a sense of their value. Generally, a detailed visualization of the board seemed to mark the amateur and was never characteristic of a proficient practiced player.

MOTOR AND MOTION IMAGES.

The motor element in mental imagery was first adequately emphasized by Stricker, in two treatises. In the former,[2] he sets forth in detail observations made on himself relative to the various elements in the word, and deals especially with the fact of initiated but suppressed articulation in his word thinking. In the second,[3] he carries his theory of motor function much further and makes it the fundamental element in both perception and memory of every kind of movement, and the basis of a doctrine of causality. A quotation from the latter work will illustrate his point of view, and also present his contribution to the motor side of mental imagery.

"My recollections of the movements of all lifeless objects are for the most part knitted with feelings in the eye muscles. If I wish to represent to myself the flight of clouds, I must connect with the image of the clouds, the feeling, as if the eyes would follow them. If I try to suppress this feeling, immediately the idea of the motion stops, and the clouds appear as if bound fast. Just as with the image of the clouds, so it is with the memory of the flight of birds, of rising smoke, of the passing vehicle."[4] So Stricker found with the images of all moving objects, as the railroad train, wheels and other rotating objects, and even the hypothetical motions of molecules and atoms. In other chapters, he treats the muscle feelings which accompany the perception and representation of movements of living objects and of parts of his own body. Other writers on the motor side of mental imagery have limited themselves entirely, so far as could be ascertained, to the articulatory impulses in word thinking.

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[1] p. 284 ff.

[2] Studien über die Sprachvorstellungen, 1880.

[3] Studien über die Bewegungsvorstellungen, 1882.

[4] p. 17.

The experience of the writer coincides exactly with that of Stricker, so far as eye movements are concerned, and so does that of two of the subjects examined. A few tests are presented in the following.

(1) *Heavy line in long parallelogram to be seen moving.*

St. Had some trouble in starting it; sort of mass movement not clearly outlined. Moved rhythmically with eye movement which was very distinct. Continuous.

K. Right end was normal size, part to left of spot was smaller. Then spot took up position at corresponding place on other end, then back; repeated three or four times. Lines were very vague. Left end distorted further by becoming tube, this did not extend to rest of it. No eye movement noticed.

(2) *Figure of pendulum ready to swing.*

St. Eye movement clear. Seemed to feel a distinct accent on start of swing.

K. Felt when saw it that it would be impossible to avoid having it move. First part clear was bob and line which seemed decidedly behind it; then filled in rest of pendulum. Did not move as was expected but seemed held there. At last got it to the other side but only by going to the suspension point and coming down. Moved it back to its original position in the same way. Had queer feeling when saw it hanging there and not going.

(3) *Circle with ball to move around circumference.*

St. Felt eye movement distinctly. Image came up readily but somewhat distorted. Ball moved around about every two seconds. Remained fairly distinct; circle clear where ball was.

K. Imaged clearly about one-fourth of circumference on each side. Then clear image of ball and completed the circle. Came back to ball and it went up to left a little; circle bulged at that point and ball stopped; whole circle fairly distinct. Then vague spell of about one second before call.

Sd. ("Swinging pendulum" called.) Got large pendulum in motion but not clearly in motion at all points; more pulled off to left. Seen as clearly as in actuality. Tendency strong to swing head in time. Half way through attention was caught by retinal light, so lost pendulum but still kept time to it; behaved as if knew pendulum was swinging behind rose colored curtain.

The figures were drawn so as to show clearly the part to be seen moving and also the course of the movement, and the subject was instructed beforehand that the movement was to be produced in the image. The results, while somewhat diverse, bear clearly upon the same point, the importance of eye movements for motion images. With St, the feeling in the eye muscles was clear and continuous in all the trials. With K, no eye movement was perceptible, but he was also unable to get any movement in the images. Another difference between the two subjects suggests a relation between the motor and visual constituents of the image. St found in the first test that while the movement was clear and regular, the outlines of the figure were more or less indistinct and describes it as a kind of mass movement. He has nothing to say about the visual image in the second test, and in the third speaks of the circle as clear only where the ball happened to be in the course of its movement. The record for K shows primarily the clearness and profusion of his visualization, and again that every attempt to produce a movement resulted in a mere distortion of the figure. This would seem to indicate that the inner visual field must be constricted, and the play of attention over the parts, necessary in holding a figure of any complexity, be eliminated in order to produce a motion image. In nearly all cases the play of attention is accompanied by slight eye movements which would, of course, conflict with the movement necessary to produce the motion.

Motion images may also depend upon the activity of other parts of the body with which they have become closely associated by habit. When the writer sits by his window rocking, the vertical stick in the sash frame makes a dark line moving back and forth on the gray background of the wall opposite. If the rocking is stopped and the attempt made to image the motion with eyes closed, it is found to be impossible however much eye movement is used. When the rocking is resumed, eyes still closed, it is impossible to image the line other than as moving rhythmically with the movement of the chair.

It is admittedly a matter of the greatest difficulty, in the present state of knowledge, to estimate the extent to which motor functions influence other conscious factors. Even the study of completed action, as the counterpart of the idea, brings up problems of bewildering complexity, and the consideration of impulses, vague tendencies to movement, residual influences of past actions, etc., falls within the region of the almost entirely unknown. As to the significance of these processes, however, there can be little doubt. The image, on account of its exceedingly fleeting nature, may be taken as an index sufficiently delicate to measure the influence of some of these factors, when it can be found both in and out of connection with them. Galton describes the results obtained by the method of a certain teacher of drawing. "He trained his pupils with extraordinary success, beginning with the simplest figures. They were made to study the models thoroughly before they tried to draw them from memory. One favorite expedient was to associate the sight memory with the muscular memory, by making his pupils follow at a distance the outlines of the figures with a pencil held in their hands. After three or four months practice, their visual memory became greatly strengthened. They had no difficulty in summoning images at will, in holding them steady, and in drawing them. Their copies were executed with marvellous fidelity, as attested by a commission of the Institute, appointed in 1852, to inquire into the matter, of which the eminent painter, Horace Vernet, was a member." He also cites the case of a young Indian who was seen "tracing the outline of a print from the *Illustrated News* very carefully with the point of his knife. The reason he gave for this odd manœuver was that he would remember the better how to carve it when he returned home."[1] The following is clearly a case of the same kind.

In the course of the experiments with words and letters, the writer noticed the extreme difficulty he encountered in holding a printed letter or word as compared with those he had written. When the printed letter was visualized, it would come out in a flash and disappear immediately. The parts were distinct and normal during the instant but if held tended strongly to become distorted. The letter always seemed unfamiliar, and there was the repeated experience of giving great effort to the development of small details in order to complete the image. When the printed word was visualized, the letters were always indefinite and schematic, and seemed merely to follow in the trail of the more prominent articulatory process. Words of more than five letters required not less than two distinct acts of visualization which were lacking in any kind of continuity.

On the other hand, it was quite easy to obtain a clearly outlined and fairly continuous image of the letter or word as customarily written. In the case of the letter, the attention played over the image, bringing out one part after another in the order and same time rate, and with the same continuity as in the writing process. In the same way words could be visualized with great distinctness, and if not too long, held with some facility without the help of articulation. If the latter process was allowed to come in, whole lines could be run over easily and continuously, each word being given its appropriate place. The images were entirely, so far as introspection could ascertain, of a visual nature, and not accompanied by the slightest tendency to reproduce the writing movement.

A possible explanation of these facts is that tracing the figures merely gives greater familiarity by bringing all of the details to attention, and fixing a certain association series. Or, again, there may be a persistent motor tendency which directly reinforces the visual imagery. The two explanations may not be so very far apart, because of the known motor element in attention, and the probable motor basis for continuity in association. The importance of rhythm will be treated in another connection.

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[1] Inquiries into Human Faculty, p. 105-6.

AUDITORY IMAGES.

No department of psychological literature contains conclusions more divergent and contradictory than that dealing with auditory images. This is apparently due to two facts. First, the observations recorded are almost purely of an individual nature, and seldom made under strict conditions of experiment and analysis. Again, the investigations have been limited almost entirely to word thinking, a choice of materials that must be considered peculiarly unfortunate, because both association and apperception have established in the word an almost unanalyzable fusion of elements. The consequence is that when an investigator finds the motor element predominating or deficient in his word thinking, he puts this forward as indicating the absence or presence of auditory images. Thus Stricker[1] and Dodge[2] find the sound of the word entirely lacking, and in its place merely a movement of the articulatory organs. Egger,[3] on the other hand, finds the sound of the word predominating, and concludes that the auditory image is independent of motor factors. There is no intention here to discredit these important investigations, but merely to ask the question if theseprocesses would repeat themselves in the representation of sounds not so inextricably woven into an established complex of relations. The question is, of course, too extensive to demand full consideration in studies whose primary purpose is the investigation of words, or even one of this kind. The peculiar value of Baldwin's contribution[4] is that he points out the fact that the kind of word thinking has a deeper basis than a general fixed tendency, and depends in large measure upon associations incident to training, which may vary considerably for different departments within the same individual.

The method in our experiments, a few of which are presented here, was to give the "ready" signal two seconds before, and the call word at the beginning of the ten seconds interval.

(1) *Tuning fork.*

St. Felt tension in tongue but could not really get sound. Had sort of humming located in mouth, fairly continuous. No visual image of fork. No kind of outside setting.

K. Got sound image a little preceding visual. Visualized fork on box. Double image continued through. Did not notice movement of throat muscles. No change in breathing noticed.

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[1] Studien über die Sprachvorstellungen, 1880.

[2] Die Motorischen Wortvorstellungen, 1896.

[3] La parole interieure, 1881.

[4] Internal Speech and Song; Phil. Rev., II, p. 385.

Sd. Doubted if he got genuine auditory image. Visualized fork in laboratory room. Repeated "pong" a number of times. Attempt to make sound image kept up to end of period. Probably no external sounds entered in as they failed to fit. Fork noticed was about an octave below middle C.

(2) *Two tuning forks with beats.*

St. Visual image of two forks. Oscillation of attention between forks that really seemed external and the humming in head. Beats were only rhythm put in by emphasis in humming. Visual image had no setting, seemed just in front in air. It fluctuated considerably.

K. Visual image not so prominent. Got sound first, then visualized two forks vaguely. Beat very distinct; tendency to follow it with hand, also in vocal organs. Tendency to visualize beat as motion in air between forks with vague waves coinciding and opposing. Had been somewhat in habit of doing this.

Sd. Got it pretty well and held clearly. Visualization of forks on boxes, but not so distinct as before. Less vocal than before. First mostly auditory and toward end almost entirely motor. Beats not perfectly regular, two or three per second. Persistence seemed to depend on its being motor.

(3) *Slowly dripping water.*

St. No visual imagery. Felt distinct movement in throat. Rhythm intervals about a second long. Word "drop" was repeated with the rhythm.

K. First visual image of faucet and rather vaguely of basin. Sound image very distinct. Did not follow drop down but could feel it when it struck; some motor element in this. Eye followed waves on surface of basin. Did not notice any movement in throat. Drops came every second or so.

Sd. First indistinct visualization of water dripping. Then became very definite with visualization of leaky radiator (memory). Tendency to imitate by use of word "drip" at regular intervals. Rather more motor than auditory on the whole; continuous. At end all had degenerated into mere use of word.

(4) *Quickly dripping water.*

St. Seemed as if in room and sound outside, but no visual image of room or water. Sound was not "drop," realized that it was too slow; was a kind of "ta" repeated rapidly. Chief part of the whole complex was movement in throat. Continuous on account of rhythm.

K. At first a clear visual image of string of drops close together with very vague visual of faucet and basin. Then sound image as before only more rapid. Sound did not fit the string of drops so did not hold it. Fluctuation [illegible] sound and visual image trying to get fit. Slight [illegible] following the drops down. Got sound image [illegible]

Sd. [illegible] ecure "drip, drip" said rapidly. [illegible] Too much engaged in intro- [illegible]

[illegible]ll.

[illegible] ater falling over. M[illegible] [illegible] and deeper. Some ho[illegible] breath. Both auditory and visual pretty continuous. No tendency to use roar of street car passing outside.

K. Visual (memory) of waterfall. Motor element in following water down. Then got sound down below. At last got whole thing together—fall, basin, spray and sound. Auditory fairly constant.

Sd. Visual image more prominent than auditory. Something of auditory nature but should hesitate to call it an image. At one stage tendency to fit sound of wind outside to waterfall but given up. Whole thing weak. No motor side. Last two seconds nothing but more or less distinct memory images.

(6) *Ticking of watch.*

St. Felt clear movement of muscles. Began too slow for watch, more like clock, so forced a more rapid movement. Then came visual image of watch just out in front. Repeated word "tick." Continuous.

K. Sound image first, then visual of operator's watch. Visual constant, sound not. Motor element in sound in marking rhythm; also used word "tick." In last part was following out details of visual.

Sd. Some tendency to imitate but less than with water. One instant tried to get operator's watch, then tried to get ticking in purely auditory way. It came almost pure but slipped away very quickly each time. Came three or four times. No definite picture of watch. Ticking very rapid.

(7) *Whistling of wind.*

St. Seemed in roof of mouth. No tendency to use outside sounds. Sound was of whistling around corner of house but no visualization of house.

K. Sound preceded vague visual, localized just outside. Visualized wind as streaks in the air going around eaves; followed motion with eye. Strong wheezy whistle. No throat movement.

Sr. Something of a memory image. Fairly easy to get but hard to hold. Came and went several times; toward last seemed to come in quick gusts. Attended by visualization of corner of house and distinct tension in throat.

(1) The fact of primary importance ascertained from this series is that we are dealing with a vastly more complicated set of conditions than in any of the experiments previously considered. Images of a visual character are possessed of a certain degree of independence, and the conditions of their maintenance are chiefly, for introspection at least, to be found within themselves. Again, motor images when taken in isolation, merely require a partial repetition of the original movement or impulse to that movement. But apparently in the case of auditory images, the conditions both of obtaining and holding them have to be brought in from outside. In other words, the study of auditory images is chiefly one of association, both of ideas and sense elements. The auditory element seems to be partially distinguishable from the associative complex focused upon it, as shown in those cases where the situation was held continuously and the sound came and went. In other cases, the situation was all that could be obtained, and a word was used to fill the

place of the image, as with the dripping of water and ticking of watch.

(2) The most important incentive to the production of sound images is, without doubt, movement of the organs of articulation, especially the throat muscles. The series of tensions and positions used in actually producing the sound stand so closely connected with the image that the latter often seems to come directly from them and to be heard only inside. If they are lacking, on the other hand, in many cases mental audition is impossible. When, for example, the writer wishes to recall a phrase of music that he has heard, it can be done only after the tensions fixing the tone relations are definitely under control, which sometimes requires several days of trial. Another motor element, upon which the production of sound images depends, is rhythm. It is a kind of solid skeleton, so to speak, which supports the soft tissues. It is doubtful if a continuous, unvarying sound image can exist at all. On the other hand, one that comes at regular intervals can be produced very easily.

(3) An interesting distinction comes out in the series between two of the subjects. St really has much better auditory images than K, and is strongly motor, while K is strongly visual. When St in his introspection, analyzed his associative complexes and found the motor elements so predominating, he became very doubtful if he got any sound image at all. K, who visualized to the extent of seeing the sound waves between the forks, and the streaks of wind around the eaves, and felt no tension in the throat, was quite sure that he got distinct sound images. This raises the question as to the comparative sufficiency of the two kinds of complexes. The visualist probably proceeds more from the standpoint of the object and the enumeration of qualities. When the object stands out complete except for the sound, and the whole situation is arranged so as to point to it, it may seem present as a matter of course whether it actually appears or not, and may seem as clearly distinguishable as any of the other qualities. It is similar to the case of filling in the blind spot in the field of vision. On the other hand, the subject who visualizes little, and in whom motor elements predominate, must proceed primarily from the standpoint of these elements, and when he attempts to analyze the association and distinguish the auditory image from the movements [illegible] with it, the image has nothing to support it.

[illegible] GUSTATORY AND OLFACTORY IMAGES.

[illegible] of ten types of mental imagery observed in [illegible] visual and auditory, he finds *tactile*, of which

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[illegible] Psych. Rev. Mon. Sup., VII, p. 36 ff.

he says, "This seems to me as clear and strong as any other, occasionally stronger;" *gustatory*, of which he says, "Sour and sweet are the only tastes I revive quite clearly, the others being three parts visualization and olfactory;" *olfactory*, "These are in my own case extremely numerous;" *thermal*, "The percentage of my own thermal imagery is only 2% and contains such imageries as 'warm feet,' 'cold nose,' etc.;" *motor; imagery of pain*, "I can imagine pain, *e. g.*, that of a stubbed toe, a cut, or a pounded finger;" *organic*, such as hunger, thirst, etc.; and imagery of *emotions*. His method was to make numerous association series, classify and take percentages. The faultiness of the method is evident after a direct examination of the images. Our subjects failed to manifest such an elaborate equipment, as the following series will show.

I. (1) *Feeling of plush.*

St. Got visual image of hand passing over plush. Thought he got plush feel for a moment. Decided "creepy" feeling, due to unpleasantness continued throughout.

K. Visual image of blue plush on back of chair followed by visual and motor of moving hand. Plush feel on fingers was very clear but did not last. Slight pleasantness.

Sr. Could not get it but saw rose colored plush very distinctly. No incipient movements noticed. Effort to get dermal distinct. Visual continuous.

(2) *Clammy hand.*

St. Visual of hand. Clear clammy feel which directly went over to "creepy" feeling. Some shudder. Noticed no tendency to speak word, but distinct tendency to express repulsiveness.

K. Fairly distinct visual of hand clasped in own, then tactual and temperature combined, latter distinct. Motor of grip. Word not present. No affective quality noticed.

Sr. Clear visual of hand. No dermal. Repeated word over and over, and coupled with it feeling of repulsiveness.

(3) *Hot water.*

St. Had fair visual of hand in water. Then of wetness and temperature, not very clear. No tendency to use word.

K. Visualized hand and hot water. Tactual and temperature of water localized in fingers quite clear (mem. from experiment). Organic and affective elements present.

(4) *Plunge into cold water.*

St. Distinct visual image of self going into bath tub, followed by sort of shudder. This kept repeating itself.

K. Visual (mem.) of cold shower bath. Strong organic reaction of chill. Then visual of self jumping into cold river. Saw splashing of water. Repetition several times of organic shiver.

Sr. Less visual setting than usual; seemed to be closing eyes to jump into water. Had all the chilly, spasmodic, shrinking feeling. This was momentary but kept repeating itself (about six times).

II. (1) *Salt.*

St. Flow of saliva seemed to increase. Felt a certain dryness in throat which usually comes when subject tastes salt.

K. Visual, tactual and motor together of mouth, moving tongue and contact with salt. Then for a moment seemed to get taste of salt localized on tongue.

(2) *Bitter.*

St. Seemed to feel some puckering in mouth and setting of muscles as in real bitter. Attention directed to mouth.

K. Nothing very definite. Motor and tactual images of moving tongue. Then vague visual of position of tongue and something on back of it. Fairly clear organic reaction to bitter.

(3) *Sweet.*

St. Nothing but moistening of tongue.

K. Vague visual image of tongue and mouth and vague motor of moving tongue. Then for instant visual (mem.) image of sugar. Then seemed to get a very indistinct taste image of sugar, but tactual and motor very prominent elements. No tendency to pronounce word. Not certain that he did not visualize word.

(4) *Sour.*

St. Seemed to be some change in mouth but could not distinguish what it was.

K. Visual of jug of vinegar (mem). Seemed first to smell it. Then complex of visual and motor with vague feeling of sour on back of tongue.

III. (1) *Ammonia.*

St. First trial, could get nothing. Second trial, thinks there was some kind of tension or irritation in nostrils. No associated images of any kind.

Sd. Nothing that could be called image. Some feeling in nostrils. Visual of bottle of smelling salts. Word seemed more or less present to consciousness. Inhaled. Feeling lasted only a second or two.

K. Nothing very definite. At first, a blank period of trying to recall odor. Inhaled as in act of smelling. Vague visual image of bottle with ammonia label. At last, seemed to get a vague feel of ammonia located in nostrils.

(2) *Alcohol.*

St. Visual (mem.) image of bottle, seemed right under nose. Could feel no sensation in nostrils. Breath a little irregular.

Sd. Visual of laboratory and place where alcohol is kept. Recollection of occasions when smelled it. Whole rather vague. Seemed at last to get some faint whiffs.

K. First, distinct visual of big laboratory bottle with label on it. Motor of breathing. Finally seemed to get some faint recognition of
e. Not very distinct. Slight feel of temperature, "cool

nt that here we have the association process, dis-
auditory images, going a step further. The ex-
rmal images in normal persons is extremely doubt-
non-existence of taste and smell images practically
ere never seems to be anything more than what
d the *intent*. There is a focusing of the associative
a special emphasis of the distinctive factors that
d the sense experience. Frequently a word is

used to fill the gap and satisfy the situation, and there is always a feeling of certainty of being able to recognize the sense experience if repeated. The words referring to these departments, that come out in the association series, are probably based upon actual sense experiences, and when recalled have nothing more than a certain associative value. This, however, is quite sufficient in everyday life, and perhaps the limitation is a necessary one, as a clear taste or smell image would undoubtedly be included in the list of illusions. We can hardly admit dream images as evidence of the actual pressence of taste and smell images because of their general hallucinatory character and the uncritical way in which they are obtained.

THE DIRECTION OF IMAGES.

Some of the subjects were tested as to the directions in which the images appeared, and the writer has for a long time made careful observation of this characteristic in his own images. It was found that the images of objects shown to the subjects invariably seemed in the same directions as the objects themselves. If an object was shown and the subject wheeled so that it was back of him, he seemed to be looking at it through the back of his head. The same was true of familiar objects about the room. The actual directions were in every case preserved.

Concerning objects not actually present, as houses, rooms, etc., in the vicinity and elsewhere, the following results came out. (1) When the name of an object lying in a definitely known direction is called, as a familiar building in the city, if it has ever been seen from a point on the line of direction from it to the subject, this direction is preserved, the aspect perceptible from that point appearing and seeming to be observed directly from where the subject actually is. For example, if he is sitting in the University laboratory and is told to image the City Hall, there is first a distinct straining in that direction, front, side, or back, according to his position, and then he sees the building directly from where he is and that side of it visible from the street leading toward the University. (2) If the object has not been seen from a point on the line of direction, a double process takes place. There is first a definite feeling of the direction of a point from which it has been seen, accompanied by the appropriate setting of images, frequently with a vague image of the self in that position. Then there is a change in the feeling of direction to that of the object from that point. If the subject is in the laboratory and is told to image the front of the building, there is first a strain in the direction of the street, and then just as definite a strain back.

If every step in the experiment is noticed carefully, it will be seen that there is a rapidly recurring fluctuation from the one sense of direction with its set of images to the other. This is perhaps the reason why images of such objects are much more difficult to hold than those described in the first case. (3) With objects that have lost the particular setting that gives a definite memory quality, by reason of having been seen in many settings, the sense of direction with some is indeterminate, and with others varies in individual cases.

Here, of course, the motor element is of paramount importance. Introspection finds nothing more as a basis for the sense of direction than certain combinations of strains. When an object is localized in front, the eyes are kept in that direction, and there is a distinct release of tension; when localized back of the head, there is a distinct increase of tension in the antagonists; when localized on the side, the eye is drawn partly in that direction. Combined with these eye movements are the minutely graded contractions of head, neck, and even abdominal muscles.

CONCLUSION.

While our data are insufficient for any very definite or far reaching conclusions, the work seems to throw light upon one or two facts respecting the behavior of images. These are, (a) that the factors which keep visual images in clear consciousness are their own internal organization combined closely with motor elements; (b) that auditory images appear only in connection with an organized associative situation, in which motor elements usually play a predominant part; (c) that images from other sense departments also require such a situation which is, in most cases, all that appears, so that the real existence of these images is doubtful.

There are certain general questions bearing upon the work, whose consideration is necessarily of the most unsatisfactory kind. One of these is whether the images obtained under introspective conditions are the same as the normal working images of everyday life. It may be that voluntary recall and control, and the process of analytical examination produce a result varying considerably from the normal sequence of images. But since introspection is the only means of approaching the images, the question must necessarily remain unanswered.

Another [illegible] is that of the means by which a subj[illegible] images. In at least two cases, part[illegible] be disparate, as when with St [illegible] slow, and with K the sound [illegible] Apparently there is a standard [illegible] which it is tested, [illegible], and we have to deal with a situation which is not merely a self-adjusting memory complex. The problem is one which falls within the discussion of recognition and not of images proper.

AN HISTORICAL STUDY OF THE EDWARDEAN REVIVALS.[1]

SAMUEL PERKINS HAYES.

INTRODUCTION.

In the study of any great popular movement it is essential to take account of the mental, moral and physical conditions of the people involved. It has therefore seemed best to recall very briefly some of the most important events in the early history of New England in order to assist us in forming a clear conception of the general state of affairs in the early part of the eighteenth century.

The history of New England might be summarized in one large word—*struggle*. Nature gave almost nothing. From the thin, rocky soil, bare subsistence could be won only by incessant labor and the strictest frugality; the climate made a severe strain upon the stoutest constitutions. Indian wars drained the colonial treasury and almost exhausted the nervous energy of the colonists. In the early period, internal theological conflicts were incessant and in the provincial period, friction with the mother country constantly sapped the vital force of the people. The following list of events will give some idea of the "temper of the times."

1620. Founding of the Plymouth Colony.
1630. Founding of the Massachusetts Bay Colony.
1633–5. Hostilities between Plymouth Colony and French.
1636. Banishment of Roger Williams.
1636–8. Banishment of Anne Hutchinson.
1635–7. Migrations to Connecticut.
1637. Pequot War.
1637. First Synod of Churches.
1640–4. End of Puritan Exodus.
1643. Confederation of the Colonies.
1646–51. Presbyterian Cabal and Cambridge Platform.
1649–51. Oliver Cromwell and the Commonwealth.

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[1] This paper is one of a series written by the members of a Seminary in Church History engaged last year in a study of the rise and development of the "New England Theology." The special purpose of this paper was to trace some of the relations between this theology and the revival of religion so aptly named "The Great Awakening." The paper has been somewhat revised.

1656–61. Persecution of the Quakers.
1657–62. Half-Way Covenant.
1660. Restoration of Charles II.
1671–86. Struggle with Charles—Overthrow of the Charter.
1674–78. King Philip's War.
1686–89. Tyranny of Andros.
1692. New Charter of William and Mary.
1689–97. King William's War.
1690. First Colonial Congress.
1692–3. Salem Withcraft.
1696–1749. Suppression of Colonial Manufactures.
1702–10. Queen Anne's War.
1722–25. War with the Northeastern Indians.
1734–5. Revivals in Northampton and vicinity.
1740–1. Great Awakening.
1744–48. King George's War.
1755–60. French and Indian War.

But especially important for our purpose is the religious history of New England. The great ideal in early Massachusetts was the founding of a Puritan Theocracy—a state fashioned upon scriptural models and ruled according to scriptural teachings. This state was to be composed entirely of Puritan Christians; all others must be rigorously excluded; only church members were to be citizens. But in the attempt to realize this ideal, difficulties were encountered on every side. Strangers came to the colony preaching foreign and conflicting doctrines: these must be silenced or excluded. Hence after an ineffectual attempt to dissuade or silence them, the authorities banished Roger Williams in 1636 and Anne Hutchinson soon afterwards. Between 1656 and 1661 came the long struggle with the Quakers, and although the Puritans were unable either to silence or to exclude *them* and at last accepted the inevitable and ceased persecution, they never really gave up the strict theocratic idea until the issuance of the New Charter of William and Mary (1692) which secured liberty of conscience to all but "Papists" and extended the franchise to all freeholders fulfilling certain property qualifications.

Within the colony, too, there was an ever increasing tolerant party. This is indicated by the constituency gained by Roger Williams and Anne Hutchinson. This tolerant element was also, doubtless, influential in putting an end to the persecutions of the Quakers. Among such "liberals" should be counted (1) the malcontents or "anti-administration party" which tends to develop in every community where one faction holds the power for an extended period, (2) many of the young people born in the colony but chafing under the strict rule of their elders, and (3) all persons who had come under the influence of the Plymouth Colony of "Separatists," who had come to America to gain freedom of conscience and not to establish a "Theocracy." That differences of opinion on many important subjects existed almost from the beginning, is well shown by the fact that the First Synod of Churches in 1637 succeeded in unearthing "82 opinions some blasphemous, others erroneous and all unsafe," besides "9 unwholesome opinions," all of which it consigned "to the devil of hell from whence they came."

Within the Puritan Theocracy itself an important doctrinal change had gradually taken place which is of vital importance for our discussion, being in fact the central question of the revival theology:—the nature of "regeneration"—the doctrine of the "new birth." The original Theocracy had been composed wholly of church-members, born and reared in England. These people had been baptized in infancy or early childhood, and at maturity, upon experiencing conversion, had been received into the church as apparently regenerate and hence on their way to Heaven. It was the most zealous only that were willing to leave their ancestral homes to brave the unknown perils of the western wilderness. But among those born in New England, especially in the second generation from the settlers, there were many good people who, although duly baptized in infancy, never experienced conversion; and as they were thus never received into "full communion," *their* children were not even baptized. It looked as if many young people were thus drifting away from the church, and to retain them the "Half-way Covenant" was devised (1657–1662) with the provision that descendants of baptized church-members should be baptized and admitted to part of the privileges of church members although not received at the Lord's Supper. This action of course gravely affected popular ideas of regeneration: from being the all-important and central thing in life—necessary even for respectability and citizenship—it was now pushed back into a secondary place, and although it was still regarded as essential for ultimate salvation, the general tendency was to take one's own time about the matter. The final step was taken by "the venerable Stoddard" who in 1707 published a sermon in which he maintained "that sanctification is not a necessary qualification to partaking of the Lord's Supper" and "that the Lord's Supper was a converting ordinance." This theory found ready acceptance and was soon widely adopted in New England. The result was marked. Instead of the strict Calvinism which taught that man was totally depraved and could never do or think anything aright until God had poured out His divine grace and regenerated his life, there arose a sort of Arminian self-sufficiency. Morality, not conversion, now became the chief care in life. And as the unregenerate found themselves quite able to commence and carry on a series of "good works" without supernatural aid, they soon came to conceive this as their chief duty: conversion was God's work—let Him accomplish it in His own time. With this separation of morality from regeneration, conversion itself assumed a mystical, inexplicable character. Moral and capable men found their way even into the pulpits: who could tell whether one had been converted or not, if it did not show in changed conduct? In such a community there was imminent danger of a return to the doctrine of "salvation through works," and Jonathan Edwards's great sermons on "justification by faith" were most seasonable for leading New England back to Calvinism.

There was still another complication in the religious situation. The New Charter had thrown open the colony to invasion from abroad; and very soon theologically heterogeneous elements began to make their appearance.. The skeptical and rationalistic tendencies of England found fertile soil in America. Episcopal chapels were erected and the hated Prayer Book used in public services. Even Arianism and Socinianism found able supporters.

Add to all this the rapid turning of popular thought away from internal theological debate toward the great question of the proper relation of the colony to the mother-country, the demoralizing influence of the Indian Wars of the early 18th century, and the unsettling effects of westward migration,—and we can easily understand the "religious apathy,"—the unemotional, intellectual type of religious life—of which the preachers of the period complain so bitterly.

REVIVALS OF 1734–5 AND 1740–1.

Such was the condition of New England when in 1727 Jonathan Edwards was called to Northampton, Mass., to act as the colleague of his respected grandfather, Solomon Stoddard. Something must be done and Edwards proved to be the man able to do it. In the fall of 1734 he began a series of sermons directed against the moral and theological evils of his time, which resulted in a wonderful awakening of religious interest, so that "there was scarcely a single person in the town, old or young, left unconcerned about the great things of the eternal world." Before May, 1735, the little town of Northampton with its population of 200 families boasted of "300 souls savingly brought home to Christ," and the people of Northampton, with those of many surrounding towns, were converted from a condition of low morality and religious indifference, to that of exemplary Christians, in feeling and conduct.

This revival of 1734–5 was widely discussed in the Colonies and upon the Continent, and in 1737 Edwards, at the request of Drs. Watts and Guyse, of England, wrote his "Narrative of Surprising Conversions," which spread the news still further. As a result America was prepared for great things when Whitefield, the wonderful young evangelist of the Church of England, came to Boston in 1740. Then began that remarkable series of revivals which has so fitly been named "the Great Awakening." Night after night crowds rushed to hear him, and responded to his stirring appeals with emotional outbursts. Here, and everywhere that he stopped in his great tour through the Colonies, large numbers professed conversion. Everywhere religion revived. Numbers of the ablest ministers of the time took up the work at home, many others became itinerant preachers like Whitefield. Among the most successful were Gilbert Tennent (a Presbyterian of New Jersey who went to Boston soon after Whitefield's departure and became a very successful revivalist), Jonathan Edwards and his pupil Joseph Bellamy, Parsons, Wheelock, Pomeroy and Graham. So strong was the religious movement that few people could keep still and soon there appeared large numbers of lay-exhorters, "men of all occupations who are vain enough to think themselves fit to be teachers of others," "of no learning" and "small capacities," "babes in age as well as understanding," "chiefly young persons, sometimes lads or rather boys—nay women and girls"—even "negroes."

Such a movement is bound to take on extreme forms. This tendency soon developed, and under the lead of such extremists as Barber, who claimed immediate revelation and direction from the Holy Spirit, and Davenport, whose methods were so irrational that a Boston jury and the Connecticut legislature both pronounced him insane—under the lead of such men the emotional element was so emphasized that their religious meetings became little else than riots.

Of course there was a vehement protest against such a development. In this all the best men united. But many went [illegible]ther and soon we find two distinct parties arising, [illegible]etting the excesses and disorders that had become [illegible]evalent, but taking different views of their frequency [illegible]g: one party considering these disorders as excep-[illegible]ooking upon the movement in general as a glorious [illegible]d and therefore to be promoted; the other party [illegible] disorders to be the rule, and true conversions the [illegible]—and regarding the movement therefore as a work [illegible] upon corrupt human nature, and to be heartily [illegible]l.

THE "OLD LIGHTS" AND THE "NEW LIGHTS."

Jonathan Edwards was far more than a theoretical reasoner; above all things he was a practical worker. Called upon to meet a situation he used the tools at his hands—he preached the Calvinism that was his by birthright and by training—but all the time his mind was intent upon the needs of the times and he used his theology as a means toward the ends of higher morality and purer personal religion. Out of his attempt to explain the facts of his own religious experience and that of many of his hearers in terms of Calvinism, grew up the New England theology; out of his experience in revival work grew up the working principle of the "New Light" party—"Press unto the Kingdom."

A critical study of the results of the revival led Edwards to see a certain well marked series of steps from religious indifference to what he regarded as true conversion. These steps, as he observed them in his own experience and in the experience of others, he tried to explain by his theological system.

First comes the conviction of one's sinfulness and guilt; then a period of intense struggle during which the awakened sinner tries by all sorts of works and religious exercises to set himself right with God—often ending in despair and utter hopelessness of ever attaining justification and salvation; at last there comes to many—not to all—a beautiful peace and joy; all the world seems new; all doubts and struggles subside and the convert's heart is filled with a sense of assurance and peace. To this Edwards applied his Calvinism. Natural man, corrupt by nature, must be awakened from indifference by the strongest possible presentation of the facts of his sinful condition—the infinity of his sin as against an infinite God—and be warned with all the terrors of hell if he continues in such a state. Realizing his perilous condition, man will of course make every effort to save himself. But man is absolutely dependent on God for saving grace, and if God does not choose to elect him, despair and utter hopelessness must be the end of man's efforts. If, on the other hand, God does elect him, conversion—a new nature—will follow and he will be at peace with God, righteous and completely happy. All this has a logical basis in Calvinism. Total depravity, unconditional election and irresistible grace easily justify such preaching and explain its results.

But Edwards saw another fact in the revival movement not so easily accounted for. He observed that a large proportion of those who, after conviction of sin, exerted themselves to get salvation, at last succeeded and showed convincing signs of a changed nature. This pointed in just the opposite direction from unconditional election. Why does God elect the most zealous? This question Edwards never satisfactorily answered; but on this observed fact, inconsistent as it is with his theological system, he based his whole practical revival work. "Press unto the Kingdom" was the shibboleth of Edwards and his school. "Be violent for the Kingdom of Heaven." Why? Does God save any man for his works? No. Justificaton is by faith alone. Can man save himself? No. Saving grace is the gift of God. Can man even turn to God before God gives his grace? No. Man's will follows his inclination and his inclination is away from God and always must be till God changes his nature and gives man a taste for divine things. Why then preach that man should be violent for the Kingdom? Because scripture clearly commands men to do so, and because observation shows that a large proportion of the most zealous succeed and receive saving grace. This is the "Edwardean paradox"—urging man to turn to God, when, according to the doctrine of total depravity, man is powerless to turn toward God, till God regenerates him.

Such is the basis of the school called "New Lights"—Christian religious experience interpreted by means of Calvinism—Christian religious loyalty and zeal rewarded by success as practical observation shows.

But by another set of men the whole revival movement was explained in another way. The "Old Lights" to be sure were at first conspicuous mainly because of their protests against the emotional excesses and the practical disorders of the movement, but as we look deeper we see that back of all this was the belief that the kingdom of heaven could *not* be thus taken by storm. They had the same Calvinism, but their observations led them to a different conclusion concerning the results of the revival movement. The New Lights claimed many true conversions and admitted incidental disorders. Such being the results the sort of preaching and the methods that attained them must be the best. But when it was claimed that true conversions were few and disorders general, the aspect of the whole subject was changed. Edwards had no Calvinisti [illegible] for his revival watchword "Press unto the King- [illegible] Lights denied him a practical basis by claiming [illegible] rations were incorrect. As for the means of [illegible] commanded their use as a preparation for [illegible] an must obey God's commands; but as for [illegible] he kingdom"—this is unscriptural and illogi- [illegible] tendency to persuade or induce God to act [illegible] reign pleasure he feels disposed. We have, [illegible] ct parties within New England Calvinism: [illegible] s" preaching morality and the use of the [illegible]," but consistently leaving conversion to God and patiently awaiting his action; the "New Lights" preaching the "Edwardean Paradox"[1] (we are helpless to do anything good till God inclines our wills to Him, but it is our duty to "press into the kingdom") and claiming a practical basis for their position in the success of their preaching as indicated by the large number of converts.

Thus the burden of proof was thrown upon the New Lights. The question became one of an explanation of observations. The New Lights must prove that as a result of their work there had been many true conversions. We shall consider rather fully the list of abuses and disorders against which Chauncy writes in his "Seasonable Thoughts," because this will give us a picture of the movement; but our chief interest must be with Edwards's defence of the movement wherein, while lamenting most of the abuses against which Chauncy writes, he also seeks to give a positive basis for his system by showing the true nature of conversion. If conversion is what he claims it is, then the large number of such converts proves the activity of the Holy Spirit and justifies his method of "pressing into the kingdom."

I. REVIVAL ACTIVITY OF THE NEW LIGHTS.

As we have seen, enthusiasm for the revival movement was very widespread, and large numbers both of ministers and laymen began to travel about and preach wherever they could get an audience. Whitefield and Gilbert Tennent were very prominent, but they do not fall within the province of this paper. Joseph Bellamy became very famous for his great oratorical powers, holding "the passions of the auditory at his command." Of many other men we hear considerable, but the most important for us is the founder of the New England school—Jonathan Edwards. Just what was his method? What did he preach and how? What were the results?

JONATHAN EDWARDS.

The purpose of Edwards in his revival work was to foster in his hearers a warm emotional type of religion, touched and vivified by a sense of immediate communion with God. This he felt sure would blossom in noble Christian conduct and thus redeem the community from the laxity of morals so prevalent at the time. Thus his aim was primarily religious—with morality as the fruit of religion.

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[1] A popular version of the Edwardean Paradox quoted by Chas. G. Finney in his sermon on "The Traditions of the Elders."

You can and you can't.
You shall and you sha'n't.
You will and you won't.
You'll be damned if you don't.

The unconverted—the sinner—must be awakened. How? In his natural state man is sinful and has no moral quality to which one may appeal. Hence the appeal is to selfishness—man's hope of future Heaven, rather than Hell. Over and over we find in his sermons the following series of arguments:

1. The unconverted are in a condition of infinite sinfulness —guilty of sin against infinite goodness and love—and therefore justly deserve the infinite punishment which now awaits them and from which only the goodness of God has kept them free up to this time.

2. This punishment is utterly beyond imagination—universal, eternal, intolerable—the most extreme that an infinite God infinitely enraged can invent.

3. The only hope of escape is by the free gift of salvation from God. This cannot be won by man's efforts, but if one is violent in seeking salvation and diligent in fulfilling all the duties God has prescribed, there is a probability that God will give him saving grace—although, of course, He is not bound to do so. Therefore, be violent for the kingdom, give up your whole life to violent endeavors to press into the kingdom. Such discourses, he says, have been the ones most remarkably blessed.

This perhaps does not seem especially awakening to us—the whole scheme may appear ridiculous and tend to raise mirth rather than fear and conviction of sin. But we must not forget the changed conditions of our times. In a day when belief in Hell was as firm and fundamental as our belief in the laws of gravity, what a powerful weapon the preacher had in his hands. The Catholic Church shows us how compelling this belief can be made. Then add to this fact the tremendous power wielded by the man Jonathan Edwards, in whom we find such a striking combination of searching irrefutable logic with a vivid oriental imagination kindled by strong religious emotions and founded upon a most severe but triumphant religious experience; taking all this into consideration is it so surprising or inexplicable that a "great and earnest concern about the great things of religion and the eternal world became universal in all parts of the town and among persons of all degrees and all ages; that "many were awakened with a sense of their miserable condition by nature, and the danger they are in of perishing eternally;" that large numbers were so alarmed as to "immediately quit their sinful practices" and "devote themselves to an earnest application to the means of salvation, reading, prayer, meditation, the ordinances of God's house and private conferences, making constant inquiry 'What shall we do to be saved?'" that some were so overcome with fear as to cry out in the midst of the service, or to weep or turn pale, or even fall into convulsions; that some, indeed, were so affected that their health was impaired causing them to sink down under the intensity of their contending emotions. Perhaps it will be well to look at some of the revival sermons of Edwards in detail. Take for instance his famous sermon preached at Enfield, July 8, 1741, upon the text "Their foot shall slide in due time," from Deut. 32:35, entitled "Sinners in the hands of an angry God." His proposition is "There is nothing that keeps wicked men at any one moment out of Hell, but the mere pleasure of God." This he discusses under ten headings: (1) "There is no want of power in God to cast wicked men unto Hell at any moment." (2) "They deserve to be cast into Hell; so that Divine justice never stands in the way; it makes no objection against God's using his power at any moment to destroy them." (3) "They are already under a sentence of condemnation to Hell." (4) "They are now the objects of that very same anger and wrath of God that is expressed in the torments of Hell." (5) "The devil stands ready to fall upon them and seize them as his own at what moment God shall permit him." (6) "There are in the souls of wicked men those hellish principles raging that would presently kindle and flame out into hell fire, if it were not for God's restraint." (7) "This is no security to wicked men for one moment that there are no visible signs of death at hand." (8) "Natural men's care and prudence to preserve their own lives or the care of others to preserve them does not secure them a moment." (9) "All wicked men's pains and contrivances which they use to escape Hell, while they continue to reject Christ and so remain wicked men, do not secure them from Hell one moment." (10) "God has laid himself under no obligations by any promises to keep any natural man out of Hell one moment."

By way of application Edwards pictures the everlasting torments of hell in glowing colors, and enlarges at length upon the infinitely terrible wrath of his angry God, with a reiteration of the utter impossibility of escape for sinners unconverted. But now is a time of "extraordinary opportunity, a day wherein Christ has thrown the doors of mercy wide open and stands calling and crying with a loud voice to poor sinners—a day wherein many are flocking to him and pressing into the kingdom of God." "Therefore let every one that is out of Christ and hanging over the pit of Hell now awake and fly from the wrath to come."

This sermon can easily be parallelled by many others; as, for example, that of May, 1735, entitled: "Wrath upon the wicked to the uttermost;" that of April, 1739, upon "The Eternity of Hell Torments;" or that of April, 1741, to prove "The Future Punishment of the Wicked Unavoidable and Intolerable."

Of course Edwards preached upon other subjects also, but the sermons that awakened his hearers were those that appealed to the emotions, especially the emotion of fear, cast in the form of cold logic but illumined with a surprising wealth of brilliant and vigorous imagery.

DAVENPORT AND THE EXTREMISTS.

But, as we have seen, there was another wing of the new lights whose violent measures and emotional excesses brought the whole movement into disrepute. Of these men the most prominent was James Davenport, whom Chauncy seems to regard as the most extreme example of all the "Things of a bad and dangerous tendency," against which he writes his "Seasonable Thoughts upon the state of Religion in New England." "It is well known," he says, "no preacher in the new way has been more noted for his instrumentality in producing these shriekings and faintings and tremblings than the Rev. James Davenport, of Southold." And one of the charges exhibited and proved against this Mr. Davenport, when brought before the General Assembly of Connecticut, was that "he endeavored by unwarrantable means to terrify and affect his hearers," namely "(1) By pretending some extraordinary discovery and assurance of the very near approach of the end of the world.

"(2) By an indecent and affected imitation of the Agony and Passion of our blessed Saviour, and also by voice and gesture, of the surprise, horror, amazement of persons supposed to be sentenced to eternal misery. And

"(3) By a too peremptory and unconditional denouncing damnation against such of his auditory as he looked upon as opposers, vehemently crying out that he saw hell flames flashing in their faces and that they were now! now! dropping down to Hell!"

"An account of Mr. Davenport's preaching," says Chauncy, "not altogether unlike this, a gentlemen in Connecticut wrote to one of the ministers of this town, upon his own knowledge, in these words: 'At length he turned his discourse to others and with the utmost strength of his lungs addressed himself to the congregation under these and such-like expressions, viz.: You poor unconverted creatures in the seats, in the pews, in the galleries, I wonder you don't drop into Hell! It would not surprise me. I should not wonder at it, if I should see you drop down this minute into Hell. You Pharisees, hypocrites;

now, now, now you are going right into the bottom of Hell. I wonder you don't drop into Hell by scores and hundreds. Etc.' And in this manner he ended the sermon! 'T is then added: After a short prayer he called for all the distressed persons (which were near twenty) into the foremost seats. Then he came out of the pulpit and stripped off his upper garments and got up into the seats and leapt up and down some times and clapt his hands together and cried out in these words: 'The war goes on, the fight goes on, the Devil goes down, the Devil goes down;' and then betook himself to stamping and screaming most dreadfully. And what is it more than might be expected to see people so affrighted as to fall into shrieks and fits under such methods as these?' "

Just how much there was of this extreme sort of work it is very hard to determine accurately. Chauncy arraigns Messrs. Pomeroy, Wheelock, Allen and Bliss as being of one soul and as having the same method of conduct as Davenport, "though I believe," he says, "Mr. Davenport has outdone them all." Chauncy does not attribute such excesses to Edwards, nor does he make this his main criticism of Whitefield and Tennent, but he considers such work to be the logical result of emotional preaching; and because of the wide prevalence of such excesses he is convinced that the Revival is not the work of the Holy Spirit and should be suppressed.

II. CRITICISM OF THE REVIVAL MOVEMENT BY CHAUNCY.

As we have seen, the great question at issue between the Old and the New Lights was "what shall we do to be saved?" The New Lights pointed to large numbers of professing converts and said, "See; those men got salvation by being violent for the kingdom of heaven; therefore that is the proper way. We of course do not claim that man can thus save himself, but observation teaches us that this method succeeds." The Old Lights replied: "A good part of your professing converts are no converts at all. The movement has been a series of emotional outbursts which are no sign of true conversion, and the unchristian spirit of many of the leaders of the movement, together with the disorders and extravagances which have been everywhere prevalent, prove that the movement is not a work of the spirit. True conversion is always marked by a change of nature, and a changed nature always blossoms into the fruits of the Spirit which are described in Scripture." Thus, the real question is the nature of true conversion. Chauncy and Edwards both claim that conversion consists in a change of nature, and both see in Christian conduct the chief sign of this regeneration, but Edwards's idea of the affections as a great part of true religion is lacking in Chauncy, and as a result those emotional excesses which are so easily disposed of by Edwards are an insuperable barrier to Chauncy, and lead him to an opposite opinion of the revival as a whole.

In Chauncy's opinion the fundamental error of the revival movement is the belief that true religion consists in emotional expressions and not in Christian conduct; and from this belief spring the various disorders and excesses against which he writes.

1. Errors in Doctrine. These may be thus summarized: If true religion consists in emotional expressions, then the more emotion one has the more religious one is; and since all religion is impossible to man in his corrupt natural state, such an emotional awakening is clear proof that God's saving grace is working within him. Emotion being a sign of the presence of the Spirit it is possible for every one to know whether he is savingly converted and to tell the same of his fellows—whether laymen or ministers. The ability to state the exact time and circumstances of one's first emotional awakening is a proof of one's conversion. If one cannot tell when he was converted doubtless he is not converted. With the spirit in one's heart working to save, what need has man to perform the "means" of grace which God intended only as a preparation for the Spirit's coming? How natural to attribute dreams and unusual visions and the sudden remembrance of Scriptural texts to the direct inspiration of the Spirit and therefore to claim for oneself special divine guidance in all the acts of life—in deed and speech—such as the Apostles enjoyed!

2. Errors in Practice. Such theories are very fruitful of erroneous methods.

(A) *Appeal to Emotions.*

If emotion is the essence of religion, and bodily effects the clearest signs of its presence, then any methods which tend to arouse the emotions are legitimate—nay, most admirable. Hence the great effort to induce extreme fear in the minds of the hearers with "all the terrible words they can get together and in such a manner as to naturally tend to put weaker minds out of possession of themselves," so that "'tis no unusual thing for persons to be plunged into the utmost agony and distress, which is often attended with a trembling of the body, fainting, falling down, etc."

"The way in which these fears have been excited in many places is not in my opinion (he says) the best evidence in favor of them. People have been too much applied to, as though the preachers rather aimed at putting their passions into a ferment, than filling them with such a reasonable solicitude as is the effect of a just exhibition of the truths of God to their understandings. I have myself been present when an air of seriousness reigned visibly through a whole congregation: they were all silent and attentive, having their eye fastened on the minister as though they would catch every word that came from his mouth; and yet because they did not cry out or swoon away, they were upbraided with their hardness of heart, and ranked among those who were sermon-proof, gospel-glutted, and every topic made use of, with all the voice and action the minister was master of, to bring forward a general shriek in the assembly; nay, in order to give the people a plain intimation of what he wanted, this same preacher sometimes told them of the wonderful effects wrought by the sermon he was then preaching—how in such a congregation they were all melted and dissolved, and in another so overpowered that they could not help screaming out or falling down as though they had been struck dead. Nay one of the preachers in this new way was so open, some months ago, as in plain words to call on the people to cry out, and plead with them to do so. This he did several times in one sermon, and had upon it so many loud cries. And 't is too well known to need much to be said upon it that the gentlemen whose preaching has been most remarkably accompanied with these extraordinaries, not only use in their addresses to the people all the terrible words they can get together, but in such a manner as naturally tends to put weaker minds out of possession of themselves." Then follows an account quoted from the letter of a friend in the country, whose record, Chauncy assures us, may be relied upon, "For it is given by one capable of making observations, and who bears as unblemished a character as most ministers in the country." This record is as follows:

"Under the preaching and exhortations of these itinerants and exhorters (the manner of which is frequently very boisterous and shocking, and adapted to the best of their skill to alarm and surprise the imagination and passions), 't is no unusual thing for persons to be plunged into the utmost anxiety and distress, which is often attended with a trembling of the body, fainting, falling down, etc. The preacher now frequently grows more tempestuous and dreadful in his manner of address, and seems to endeavor all he can to increase and spread the rising consternation and terror of their souls, which by this means is sometimes spread over a great part of an assembly, and in a few minutes from its first appearance. I have seen the 'struck' (as they are called) and distressed brought together from the several parts of the assembly into the square body by themselves, smiting, stamping, and crying out to them with a mighty voice in the most terrible manner and language: the poor creatures fainting, screeching, and bitterly crying out under them. You may easily think what terrors of imagination, distraction of passions, and perplexity of thought they endured. I was last summer at an evening lecture at a neighboring parish, at which one of the most famous preachers in the new method carried on. He had entered but a little way in his sermon (which was delivered in a manner sufficiently terrible), when there began to be some commotion among the young women. This inspired him with new life. He lifted up his voice like a trumpet, and plentifully poured down terrors upon them. About half a score of young women were presently thrown into violent hysteric fits. I carefully observed them. When he grew calm and moderate in his manner, though the things delivered were equally awakening, they by degrees grew calm and still; when he again assumed the terrible and spake like thunder, the like violent strugglings immediately returned upon them from time to time. Sometimes he put a mighty emphsis upon little unmeaning words, and delivered a sentence of no importance with a mighty energy, yet the sensible effect was as great as when the most awful truth was brought to view."

A similar account Chauncy quotes from the Boston Post-Boy, No. 391, which speaks of itinerant preachers as follows: "Their main design in preaching seems not so much to inform men's judgments, as to terrify and affright their imaginations: by awful words and frightful representations to set the congregation into hideous shrieks and outcries. And to this end, and in every place where they come, they represent that God is doing extraordinary things in other places, and that they are some of the last hardened wretches that stand out; that this is the last call that ever they are likely to hear; that they are now hanging over the pit of destruction, and just ready this moment to fall into it; that hell fire now flashes into their faces, and that the devil now stands ready to seize upon them and carry them to hell; and that they will often times repeat the awful words. 'Damned! Damned! Damned!' three or four times over."

(B) *Censoriousness.*

If strong emotions give one assurance of conversion, it is easy to conclude that those who have not experienced the same kind of awakening are unconverted—are therefore not true Christians and certainly no fit persons to occupy the pulpits of the land. This censorious spirit "appeared first of all in Mr. Whitefield, who sel [illegible] reached but he had something or other in his se [illegible] ministers." And as though he [illegible] g he expressed his fears in his Journal of New England lest "many, nay the most that preach do not experimentally know Christ."

Gilbert Tennent showed a like spirit. Chauncy says "His preaching in Boston was censorious beyond what can be easily imagined." "But the most remarkable instance of this kind is the Rev. Mr. James Davenport, of Southold," who was so violent in abuse of the ministers that many refused to let him preach in their pulpits, and when brought to Court for his libellous conduct he was acquitted only on the ground that to use such language he must be "*non compos mentis.*"

This same censorious spirit soon became widespread all over the country among the common people, "Parents condemning their children and children their parents, etc."

(C) *Claim of Immediate Inspiration.*

If religious emotions are a sign of the presence of the Holy Spirit, how natural it is to claim that verses of Holy Scripture coming into the mind with great force and peculiar fitness to one's conditions are the direct gift of the Holy Spirit and intended to guide one's conduct; that dreams and visions and unusual imaginations are the result of special revelation; that in this time of special outpouring of the Spirit one should depend on such special illumination to guide one in even the most trivial matters or wait for promptings from the Spirit before acting at all.

"Mr. Whitefield," says Chauncy, "had evidently a turn of mind too much disposing him toward this way" of interpreting impulses, coincidences and dreams as revelations.

Davenport was extreme in this tendency as in many others, claiming divine guidance in daily conduct and revelations of various kinds, laying special emphasis upon "some extraordinary discovery and assurance of the very near approach of the end of the world," and even attempting to cure "a poor woman, living in the next parish to Mr. Davenport's, counted religious, who had been totally distracted for a long time and dumb for a season. Mr. Davenport, possessed with a notion (says Chauncy) that he could pray her into her right mind and to the use of her tongue, though the Philistines could afford her no relief, spent a day of fasting and prayer for that purpose, with a number of his admiring brethren. At this meeting (I think it was) he set a certain day, by which time, if not before, he was assured she would be delivered and recover her speech. On that very day the woman died without having spoken a word or discovering any sign of being in her right mind. When this was objected to him he said his faith was verified and his prayer answered in the event; for that she was delivered that y day by being received to Heaven."

Yet even Davenport was outdone in claims of spiritual direction by his friend and companion Barber. Upon hearing of Whitefield's successes Davenport and Barber "applied themselves in an extraordinary manner to seek of God this outpouring of his Spirit upon the land," and "particularly that he would please more fully to instruct them what he was about to do and give them a great share of the Spirit." After a time certain texts were "powerfully impressed upon Barber's mind" and he began itinerant exhorting. As he counted that he had a special prophetic mission from God "somewhat like that of our Lord's disciples," "he took no money with him, neither change of apparel nor shoes, but was shod with boots; and as he passed along through the several parishes of Southold he publicly declared that he had laid aside all study and forethought of what he should deliver in his public speeches to the people (some who heard him thought so) and depended wholly on the immediate direction of the Holy Ghost, and that it was given him in that hour from time to time what he should say." Finally he reached an obscure place called Oldman "where he abode some months, refusing for a long time to preach to them any more," "neither could he be persuaded to remove thence" but "led an inactive, idle life till he was grown very fat and ragged, alleging in his justification that he had received no direction from the Spirit to remove thence, and must remain stationed there so long as the Cloud abode upon the Tabernacle."

Standing upon the same claim of immediate inspiration and direction were also the numerous lay exhorters who with "presumptuous dependence upon the Blessed Spirit despised learning (speaking slightly of schools and colleges) under the notion of immediate impressions from the Spirit, and that his assistance would more than supply the want of learning," and by neglecting Bible study and the means of grace therein appointed "reflect dishonor upon the written revelations of God."

(D) *Itinerant Preaching*

This custom was a natural development of the aggressive policy of the New Lights Party. The method had its rise, says Chauncy (at least in these parts), from Mr. Whitefield who was soon imitated by Gilbert Tennent. The scheme appealed to others and soon "the method of itinerant preaching became common." Edwards and Bellamy both made preaching tours, and Davenport and Barber with many others almost totally deserted their parishes and spent their whole time in such trips. This was a favorite method with lay-exhorters, who in many ways made themselves a nuisance.

This practice Chauncy vehemently attacks as improper in principle and pernicious in results.

(1) Ministers have no right to desert their own parishes without the consent of their congregations.

(2) Itinerants of any kind have no right to enter other men's parishes unless invited, and then should not take all the credit for results, but should consider the preparation made in the work of the regular pastor. Especially evil is the system when the itinerants push in against the wishes of the settled ministers.

(3) "The tendency of this practice is confusion and disorder." It tends to dissolve the connection of each pastor with his people if the pastor constantly deserts them. It leads to division of congregations into parties and the formation of separate bodies—especially as most of these itinerants claim spiritual direction and are very censorious of all who oppose them or disagree with their views.

Such then is Chauncy's criticism of the Revival Movement. It is founded on a wrong conception of what true religion is, and so has unduly magnified the emotional element in religion, leading to all sorts of excesses and extravagances. It has been carried on by methods which are inexcusable; it has been attended with numerous harsh and unchristian attacks upon those who do not sympathize with it; it has resulted in all sorts of confusion in public worship and in the government and harmony of the church bodies—unfair attacks upon settled pastors and the division of many churches into separate congregations; and far from promoting Christian life and showing those results which are the legitimate and Scriptural fruits of the Spirit it has led to Spiritual pride, censure, conflict, idleness, a neglect of the appointed "means of grace" and a dishonoring of Holy Scripture.

3. TRUE WORK OF THE SPIRIT.

But the Old Lights were more than a mere party of opposition. They too had positive theories of man's natural state, his need of conversion, the nature of conversion and its results. Their doctrine was the Calvinism with which Edwards started, colored a little with rationalism and Arminianism.

CHAUNCY'S IDEA OF A WORK OF THE SPIRIT.

Chauncy looks upon man as in a state of natural corruption. He stands in the greatest need of "that real change of heart and life without which one cannot be qualified for an admission into the Kingdom of God." This change of nature, called in Scripture "sometimes the new Birth, sometimes the Spirit's Renovation, sometimes Conversion or a being turned from darkness to light and from the power of sin and Satan unto God," is entirely the result of the free action of God's Spirit upon man. God uses various means and instruments to effect this change, but in substance it is the same "in all places and among all people under Heaven." Generally there is first a preparation in the minds of sinners, "whereby God opens to the sinner a vision of himself in his sinfulness and guilt upon which he is driven out of his former case and filled with anxiety and distress." "This is called by Divines Conviction." After this preparation begins the real work of God which is secret and hidden, "effected in the universal frame of their mind. It principally lies in a new heart, another soul, in other views and intentions, other thoughts, sentiments, other principles and springs of action." And when this transformation of nature is complete the new Christian character shows itself in cessation from sin, and a high degree of love, joy, peace, righteousness, holiness and such fruits of the spirit as are indicated in Scripture. This new nature, or "temper of mind" is a "never failing source of good works," and while no one can have absolute assurance of salvation, and "good men may be in the dark about their spiritual condition," yet it is much more likely that those who show "the fruits of the Spirit" mentioned in the Bible, are really acting under the influence of saving grace than those who give no such signs of a changed nature; and as for special revelations, etc., "the least spark of true Christian charity is a better evidence of a work of God in the soul than the greatest ability to show signs and work wonders." Moreover man has something to do. He cannot earn salvation, for this is the gift of God, and of course he cannot "press into the kingdom" against God's will; but God has appointed certain means to be attended in order to the obtainment of that help from the Spirit which is needed for salvation; such as "prayer, reading and hearing God's word and the like," and while he must guard against "the error of placing works in the room of Christ or of free grace," yet "neither the grace of God nor the merits of Christ take away the necessity of a holy life in conformity to the precepts of the Gospel," and "'t is plain, from the same Scriptures, that salvation by Grace through Christ is in the way of obedience—such an obedience as proceeds from a heart purified by faith and purged from dead works to serve the living God." God "no more ordinarily begins than carries on the work of faith as respects its existence and operation in the hearts of sinners without the concurring use of their power and endeavors." "God and man and means are all concerned in salvation."

III. DEFENCE OF THE REVIVALS, BY EDWARDS.

While heartily in sympathy with the movement and one of the chief agents in its spread, yet Edwards at an early date recognized the danger and vehemently opposed the excesses and confusions which appeared in many quarters. In 1742 appeared his "Thoughts Concerning the Present Revival of Religion," 74 pages of which he devotes to "showing what things are to be corrected or avoided, in promoting this work or in our behavior under it." Among these we find many of the same things against which Chauncy contended—(1) "censuring professing Christians of good standing in the visible church, as unconverted," attacking ministers as unregenerate "because they seem in comparison with some other ministers to be very cold and lifeless in their ministerial performances," or because of their opposing the revival movement; (2) "spiritual pride"—having a high conceit of one's own light and humility and leading to undue assurance of one's own salvation, the use of harsh and terrible language toward those deemed unconverted, "unsuitable and self-confident boldness before God and man," an improper assumption of authority in speech and conduct and often the affecting of "singularity in external appearances" or a "singular way of speaking;" (3) claims of immediate inspiration and revelation from God to guide his saints by means of scripture or impressions and impulses, with belief "that persons ought always to do whatsoever the Spirit of God (though but indirectly) inclines them to do." (4) disregard of consequences that may arise from methods which serve for present edification, such as the careless introduction of "things new and strange and that have a tendency by their novelty to shock and surprise people" and leading to persecution and opposition which in the end will hurt the cause of vital religion;" (5) disregard of external order in matters of religion and use of the means of grace"—confusion in public worship, "singing in the streets going to and coming from worship," neglecting regular family worship and staying "abroad late in the night at religious meetings;" and finally, (6) lay exhorting. Yet while freely admitting all these errors and irregularities and heartily opposing them, Edwards feels that when the movement is judged as it should be, "by its effects and not by its supposed causes," by the whole teaching of scripture and not by a part only, or by one's own experience or by philosophy, or by the history of earlier religious movements[1] which have either shown none of the good effects of this movement or only an exaggerated degree of its imprudences and excesses, and when the movement is regarded as a whole, separating the good from the bad and not viewed in part,—if thus judged, Edwards feels confident that all will agree with him that the imprudences and disorders of enthusiasts are incidental and exceptional, and the movement as a whole a glorious work of God. As such, Edwards deems it his duty to defend and promote the work; and in 1746, after the emotional excitement of the movement had largely subsided and theological questions were becoming dominant in public thought, he published a book in which he sought to get at the very root of the question. This he called "A Treatise Concerning Religious Affections," giving us (1) a discussion of the nature of the affections and their importance in religion, showing (2) why there are no certain signs indicating whether or not religious affections as such are truly the work of the Spirit, and (3) indicating what are distinguishing signs of truly gracious and holy affections, *i. e.*, what are the scriptural results of the workings of the Spirit.

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[1] For earlier revivals, see preface of Chauncy's Seasonable Thoughts and beginning of Edwards's Narrative of Surprising Conversions.

NATURE OF THE AFFECTIONS.

"God has endued the soul with two principal faculties:" the (1) understanding—"that by which the soul is capable of perception and speculation or by which it discerns and judges things"—and (2) the will or inclination—"that by which the soul is some way inclined with respect to the things it receives or considers—or the faculty by which the soul beholds things, not as an indifferent, unaffected spectator, but either as liking or disliking, pleased or displeased, approving or rejecting." "The more vigorous and sensible exercises of the will are called the affections. The will and the affections of the soul are not two faculties; the affections are not essentially distinct from the will."

In some sense the affections differ nothing at all from the will and inclination, and the will never is in any exercise further than it is affected. "The affections are no other than the more vigorous and sensible exercises of the inclination and will of the soul."

"All the exercises of inclination and will are concerned either in approving and liking, or disapproving and rejecting; so the affections are of two sorts—they are those by which the soul is carried out to what is in view, cleaving to it or seeking it, or those by which it is averse from it and opposed to it. Of the former sort are love, desire, hope, joy, gratitude, complacence. Of the latter kind are hatred, fear, anger, grief and such like."

NATURE OF TRUE RELIGION.

"Religion consists in great part in the affections," "in the vigorous and lively actings of the inclinations and will of the soul or the fervent exercises of the heart." This is clearly the kind of religion God insists upon in scripture. It is the kind of religion Christ and the eminent saints of the Bible had; and it follows in reason that as "God hath so constituted human nature that the affections are very much the spring of men's actions," therefore, "religion must consist very much in the affections." True religion of course involves the whole man, and therefore the understanding as well as the will and inclination is called into action; but "true religion consists so much in the affections that there can be no true religion without them."

NATURAL INABILITY.

The object of a religious man's thought of course is God. What conception can man form of God? What is essential to true communion? God's qualities are of two kinds — his natural perfections such as his power, knowledge, eternity, etc., and his moral perfections, such as his holiness and love. Natural men may have a sense of God's natural perfection and experience such feelings as fear, admiration, joy, etc., but of God's moral perfections natural man can have no conception. Yet it is on the moral excellencies of God that all truly holy affections are primarily founded. Moreover, natural man has no inclination, no taste for such things and therefore can never have any truly religious affections which consist of a vigorous exercise of the will and inclination towards God. Hence to have true communion with God, man's nature must be changed. This occurs at conversion.

NATURE OF CONVERSION.

Conversion is accomplished by the influence of the Spirit dwelling in men's hearts as "a principle of new nature, or a divine supernatural spring of action." The result of this indwelling of the Spirit is that the convert receives as it were a new spiritual sense—as "different from any former kinds of sensations of the mind as tasting is diverse from any of the other senses." Yet this new spiritual sense is not a new "faculty" but a new principle of nature, a new spring of action. Man continues to use "understanding," but with this new spiritual power he is able to gain "a cordial sense of the supreme beauty and sweetness of the holiness or moral perfection of (God and) divine things." Man continues to use his other faculty,—the will or inclination, but with this changed nature comes an inclination towards God instead of towards sin. Thus both his faculties are affected and with the new view of God's moral perfections and the new taste for divine things come those truly religious affections which consist in a vigorous exercise of the will and inclination toward God for his moral excellence.

FRUITS OF THE SPIRIT, IN LIFE AND CONDUCT.

Very widespread has been the mistake of attributing to the action of the Spirit many effects which are no signs, either of the presence or absence of the Spirit. Such a mistake has encouraged excesses and helped to bring the whole movement into disrepute.

The following things,—we can now perceive—are no signs either of the presence or the absence of the Spirit, for while they may accompany true conversion, they may also be produced where there is no true conversion, merely by the exercise of man's natural powers:

(1) A high degree of religious affections.

(2) Great effects on the body.

(3) Fluency, fervor, or abundance of religious talk.

(4) That religious affections arise without any effort on our part to excite them.

(5) That religious affections come to the mind in a remarkable manner with texts of Scripture.

(6) That there is an appearance of love in them.

(7) That there arise many kinds of religious affections together.

(8) That comforts and joys follow a certain order in appearing.

(9) That they dispose persons to be zealous in religion.

(10) That they dispose persons to praise and glorify God.

(11) That they make persons confident of salvation.

(12) That the accounts persons give of them are very affecting.

"Nothing hinders but that all these things may meet together in man and yet they be without a spark of grace in their hearts."

On the other hand there are certain distinguishing signs of the presence of the Spirit,—that is, there are certain effects which will always follow if the Spirit is present, but it must not be assumed that God has given us any signs by which to be absolutely certain that we ourselves, or any others, are savingly converted. ("Let no saint however eminent and however near to God, think himself out of danger.") These signs, then, do not prove the presence of the Spirit, but merely indica
Their absence, however, is good proof that the
absent.

(1) True religious affections, as we have seen, arise from the indwelling of the Spirit, which by Divine operation upon man's nature transforms it, giving a new sense by which man may rejoice in the moral excellence of divine things, enlightening the understanding and inclining the will towards God.

(2) The result of this transformation within is seen outwardly in the daily conduct of the convert. The regenerated Christian will show tenderness of heart, "such a spirit of Christian meekness, quietness, forgiveness and mercy" as appeared in Christ, and all the scriptural fruits of the Spirit in "beautiful symmetry and proportion." This outward change in the Christian is the great sign of the Spirit's presence to oneself and to one's fellows. "Christian practice is the sign of signs in this sense, that it is the great evidence which confirms and crowns all other signs of godliness." It is "as much the proper experiment and evidence of the superior inclination of the heart as the motion of the balance with different weights in opposite scales, is the proper experiment of the superior weight."

Such is Edwards's defence of the Revival Movement. In his opinion large numbers had been savingly converted; they had experienced true religious affections, and showed in their changed outward lives clear evidence of their new nature.

HALF CENTURY OF RELIGIOUS APATHY.

The Revival activity of 1735–42 was followed by a half century of popular indifference and a low status of religious and moral life. The action of the Connecticut May Court of 1742, in forbidding itinerant preaching, and the condemnation of many of the revival methods by the "Annual Ministerial Convention" of May, 1743, did much to cool religious enthusiasm. As a result of this and the wide spread opposition to many of the revivalists for their censorious spirit as well as their extravagant methods, Whitefield on his return to America in 1744 found a poor field for work and was met with intense opposition from the ministers and colleges which he had so rashly censured. Then came the doctrinal discussion accompanying the development of the New Light principles, and political and military troubles with France and Great Britain, and there seemed no chance for religion until the end of the century.

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Festschrift Wilhelm Wundt zum siebzigsten Geburtstage überreicht von seinen Schülern. (Philos. Studien, Vols. 19 and 20.) W. Engelmann, Leipzig, 1902. pp. 615 and 712.

Professor Wundt had many honors showered upon him on his seventieth birthday including the freedom of the city of Leipzig. Perhaps, however, of all the honors most prized by a German savant is a Festscrift composed of works of his own former pupils, now numerous and scattered in nearly all lands. This has taken the form of a 19th and 20th volume of his Philosophische Studien, and comprises articles by Frank Angell, P. Barth, B. Bourdon, J. McK. Cattell, Jonas Cohn, Ottmar Dittrich, Otto Fischer, Ewald Flügel, Willy Hellpach, Charles H. Judd, Friedrich Kiesow, A. Kirschmann, Edmund König, Emil Kraepelin, Oswald Külpe, Paul Rostosky, E. W. Scripture, Ludwig Lange, Alfred Lehmann, G. F. Lipps, E. Meumann, Erich Mosch, Edward A. Pace, Raoul Richter, Bastian Schmid, G. Störring, G. M. Stratton, Karl Thieme, E. B. Titchener, A. Vierkandt, W. Weygandt, Wilhelm Wirth, Julius Zeitler.

Grundzüge der Psychologie, von HERMANN EBBINGHAUS. Band I. Veit & Comp., Leipzig, 1902. pp. 694.

The first book is devoted to general questions concerning the soul, consciousness and unconsciousness, and the methods of Psychology. The second treats of the structure and functions of the nervous system. The third part considers the simplest psychic forms—first sensations and their specific qualities—to which about one hundred and fifty pages are devoted. Then follow a characterization of sensations in their general peculiarities and relations to time, space, movement, similarity and difference, unity, multiplicity, and the relations to the stimulus. Conceptions, feelings and will follow. The fourth book deals with the most general laws of psychic life, the contemoriety of psychic forms, their sequence, reproduction in experience, memory, habit, repetition, and, finally, relations of psychic processes to movements.

The Home Life of Borneo Head-Hunters: Its Festivals and Folk-Lore, by WILLIAM HENRY FURNESS. J. B. Lippincott Co., Philadelphia, 1902. pp. 197.

The writer spent twelve months in Borneo and attempts to give an unprejudiced impression of the savages he saw. It is a thoroughly unique and sympathetic narrative, copiously illustrated with several scores of photographs taken on the spot. Passionate as is the love of these people for adding to their collection of heads, which always hang over the fire in their long communal houses, and gross as is their idolatry, they are, nevertheless, on the whole attractive people as they are described in this book. They are entirely peaceable among themselves, more chaste and industrious than most savages, cheerful, but clinging tenaciously to their customs, tattooing elaborately, etc. The great charm of this book is, in a word, that the author has gone to the sources and has told us in a frank way, utterly unencumbered by erudition, exactly what he saw among people who, in some cases had never seen a white man. The tribes, he visited, are simply adult children, excitable, very superstitious especially of omens and taboos, and many of both sexes have magnificent physiques. Abhorrent as the custom is, perhaps the greatest achievement of the author is that he even makes us understand to some extent the strange instinct on which head-hunting rests.

Vergleichende chemische Physiologie der niederen Tiere, von OTTO VON FURTH. G. Fischer, Jena, 1903. pp. 670.

This comprehensive work really marks off a new field. After a few brief sections on preliminary chemical ideas, the author proceeds to discuss the blood of worms, mollusks, crustacea, insects, etc.; then takes up respiration and its organs in the lower forms of aquatic and land life. The third section discusses the nutrition of protozoa, echinoderms, worms, mollusks, crustacea, arthropods, etc., and compares them. Secretion follows next, then animal poisons, then special secretion such as coloring matter, muscine, silk and wax. The muscles are next discussed, then the frame work of the body, the pigments of the different orders of life, residual matter or glycogen, fat, lime and ash, the lips of the sexual glands, with a chapter of especial interest on the chemical conditions of existence among invertebrates. A vast body of interesting matter with tables, literature, and index of both topics and authors follows. It seems to a layman in the subject to be a masterly piece of work.

Development and Evolution Including Psycho-physical Evolution, Evolution by Orthoplasy, and the Theory of Genetic Modes, by JAMES MARK BALDWIN. The Macmillan Co., New York, 1902. pp. 395.

This work is divided into three parts; the first entitled the problem of genesis, consisting of matter that has largely been printed before; part two, the method of evolution; and part three, criticisms and interpretation. These two latter parts are "mostly new matter." Here the problems, which the writer treats with "hope with sufficient fear," are the exposition of the psycho-physical evolution and the outline sketch of the theory of genetic modes. As a whole, the work is abstract with great stress laid upon method. A copious appendix contains various papers of the author up to date, with quotations from H. F. Osborn, statements of Lloyd Morgan, discussions with Poulton, Headley and Conn, and various reviews.

Dictionary of Philosophy and Psychology. Edited by JAMES MARK BALDWIN. Volume 2. The Macmillan Co., New York, 1902. pp. 892.

The author and his many coadjutors present here the remainder of their dictionary from "Leading of Proof" to "Zwingli." Then follow indexes of Greek, German, French, and Italian terms. A third bibliographic and biographic volume is to follow.

The service of this comprehensive work is sure to be great and something of the kind has long been sadly needed. Of course the work of the different co-laborers varies greatly in value as does the work of the same writer upon different themes. Sometimes extremely valuable and new matter is given in pithy form, and the reader will know that some of even the longer articles are perfunctory and aridly general. All psychologists will, of course, welcome such a volume.

Grundzüge der Psychologie, von HUGO MÜNSTERBERG. Leipzig. 1900. pp. 562.

This volume, although more than two years old, has just been received, December, 1902. The writer first treats the problem of psychology; its present tendencies; its epistemological basis; its relations to history, science, and life. The second part, on psychic objects, discusses the relation to consciousness, to space and time; psychic manifoldness, and a description of the psychic objects. The third part, on psychic connection, treats of connection through the soul, the body, the apperception theory, biological explanation, theory of association and of action. A good part of this work, and that the most characteristic, has already appeared some two years ago in an English and American edition.

Ausgewählte Beiträge zur Kinderpsychologie und Pädagogik, von G. STANLEY HALL. Translated by Dr. Joseph Stimpfl. O. Bonde, Altenburg, 1902. pp. 454.

This is volume four of the international library of pedagogy and its auxiliary sciences, and may be followed by another volume. Dr. Stumpfl has here translated thirteen of Dr. Hall's papers. These are the Study of Children, Children's Lies, Contents of Children's Minds on Entering School, The Story of a Sand Pile, The Love and Study of Nature, Research, the Vital Spirit of Teaching, The New Psychology as a Basis of Education, The Ideal School, Some Aspects of the Early Sense of Self, A Study of Fears, and others. Several of these have been annotated by the translator who has also written an introduction of twenty-two pages giving some sketch of child study in America.

1. The Survival Values of Play. 2. A Statistical Study of Education in the West, by HARVEY A. CARR. Investigations of the Department of Psychology and Education of the University of Colorado. Vol. 1. No. 2. Boulder, Colo., Nov., 1902. pp. 78.

In the second of these studies, the author finds that as compared to groups of States called by the Census Bureau, North and South Atlantic, North and South Central and West, the latter, although the proportion of children to the population is lower than in any other section, is first in proportionate attendance and in financial equipment and proportionate support; first, in the requirements in English and History in the high school and the average length of its course and in higher education; first, in attendance of students residing in the division and in the proportionate number of such students. In other respects, it is second, third, etc.

In the first paper, Mr. Carr gives us a valuable discussion of the play question. He inclines to the survival view rather than the practice theory of Groos. Among the rapidly growing literature on this subject, we must class this paper as one of the best.

The Hearts of Men, by H. FIELDING. Hurst & Blackett, London, 1901. pp. 324.

This book is by no means a sequel to the author's notable "Soul of a People." It discusses some 30 different topics involving the nature of religion; its use; optimism and pessimism; miracle; after death; Sunday; prayer; men's faith, and women's faith; God; the sacrifice and the mother; enthusiasm; heaven; the way of life; theology, etc. Although well read this author's great charm is in the wide personal experience from which he draws his material and his unique though somewhat unsystematic style.

Die Entstehung der ersten Wortbedeutungen beim Kinde, von ERNST MEUMANN. Leipzig, 1902. pp. 69.

We have here a valuable study of the development of the first meaning attached to words by children. The writer has made good use of American, English and other authorities, and has shed real light and brought some progress to our knowledge of the early thinking and speaking of children.

Die Seele des Kindes nebst kurzem Grundriss der weiteren psychischen Evolution, von DR. J. A. SIKORSKY. Leipzig, 1902. pp. 80.

The writer first treats of the soul of the new-born child, then, at the age of three months, on the basis of tests of tactilogical and acoustic sensations with interesting remarks on feeling, knowledge, and neuro-psychic hygiene. He discusses more briefly the period from the 4th to the 10th month, from the 1st to the 2d year, and more fully from the 2d to the 6th year, with brief remarks on youth.

Child Culture According to the Laws of Physiological Psychology and Mental Suggestion, by NEWTON N. RIDDELL. Chicago, 1902. pp. 129.

The author is lecturer on heredity, psychic phenomena, inspiration, brain building and soul growth. His book is the work of one who, it would appear, has either never heard of Wundt, Höffding and the rest, or has no use for them. There is extremely little in this work that suggests physiological psychology in the sense of these writers, but the author believes in moral training, ideals, reverence, purity, the home influence, energy, and reason; but disbelieves in tobacco, domineering on the part of parents, partiality, etc.

Psychologie der Naturvölker, von FRITZ SCHULTZE. Leipsig, 1900. pp. 392.

This author seeks to prove that "the psychology of wild men is not wild psychology." To control savages, the German way is to educate them. The author has read very widely, and divides his subject into thinking, willing, and the religious views of natural men. In an appendix he gives an interesting digest of Sutherland's "Evolutionary Ethics" which appeared just after his own work was published, and which he enthusiastically approves.

Mind in Evolution, by L. T. HOBHOUSE. The Macmillan Co., New York, 1901. pp. 415.

This important work is described as an analysis. Its chapters are—mind as a factor in evolution, organic adaptability, reflex action, instinct, assimilation and readjustment, concrete experience and the practical judgment, learning among the higher animals, the method of trial and error, some experimental results, knowledge of concrete objects, articulate ideas, intelligence and the social instinct, the concept, products of conceptual thought, systematic thought, summary of the stages of correlation, organization, conflict and evolution, self conscious development.

Analystes et Esprits Synthétiques, par FR. PAULHAN. F. Alcan, Paris, 1903. pp. 196.

These two are the great movements of the human spirit to which all psychic operations submit. Different types of each are described, their qualities, defects and excesses, and the mean is found in an equilibrium between them.

Esquisse Psychologique des Peuples Européens, par ALFRED FOUILLÉE. Paris, 1903.

This is a study of national character with chapters each for Greeks, Italians, Spaniards, the English people, Germans, Russians, French, and the Neo-Latins.

Le Caractère, par D. MALAPERT. O. Doin, Paris, 1902. pp. 305.

After characterizing ethology, its object and its method, the author passes to discuss the factors of character, and metaphysical theories concerning it; those of temperament, and psychological theories concerning it; classification; and concludes with a chapter on the morbid and abnormal traits and characteristics.

Nineteenth Annual Report of the Bureau of American Ethnology. 1897-98. Parts 1 and 2. Govt. Print, Washington, 1900.

This report shows no sign of falling below the high standard always maintained by these publications, which are a great credit to American scholarship and to the liberality of our government. Among so many interesting papers it seems invidious to single out any for special mention, but certainly all will be interested in J. W. Fewkes's Tusayan Flute and Snake Ceremonies, and in his investigations of the migrations of the same tribe, and in Mr. Jenks's Wild Rice Gatherers of the Upper Lakes. The study of clans, which constitutes a large portion of the other volume, is also of a high degree of value and interest.

Les Obsessions et la Psychasthénie, par PIERRE JANET. Paris, 1903.

This elaborate work first analyzes symptoms classified under obsessive ideas, forced agitations, psychasthesic stigmata. The second part is on the general abatement of psychic tension, and first treats of psycho-genetic theories of evolution and diagnoses the treatment of the place of psychasthenia. The work follows the method of his previous book on Forced Ideas.

Psychopathological Researches. Studies in Mental Dissociation, by BORIS SIDIS. Published under the auspices of the Trustees of the Psychopathic Hospital, Department of the New York Infirmary for Women and Children. G. E. Stechert, New York, 1902. pp. 329.

This is a collection of studies by Dr. Sidis and his assistants, W. A. White and G. M. Parker. The chief topics are mental dissociation in functional psychoses, in alcoholic amnesia, in psychic epilepsy, in depressive delusional states, in functional motor disturbances and in psycho-motor epilepsy. The few typical cases here studied were selected from a mass of material, and the effort is to avoid theories and give résumés, the conclusions being reserved for another work, promised soon, entitled Principles of Psychology and Psychopathology.

Les Obsessions et les Impulsions, par A. PITRES et E. RÉGIS. O. Doin, Paris, 1902. pp. 434.

This work treats first of obsessions, impulsive and ideational; hallucinations; phobias, their cause, progress, duration, prognostics, diagnostics, and treatment. The second part is devoted to the impulses.

Zur Psychologie und Pathologie sogenannter occulter Phänomene, von C. G. JUNG. Leipzig, 1902. pp. 121.

This young Zurich psychiatrist first discusses an interesting case of somnambulism in a spiritual medium. Then passes to the development of somnambulic personality, hemi-somnambulism, automatism, hallucination, change of character, relation to hysterical attack and the patient's speech, etc.

Martineau's Religionsphilosophie, von ORLO J. PRICE. Newark, O. pp. 103.

American students of philosophy abroad are doing a good service in spreading knowledge of American and English systems by choosing for the topic of their dissertations brief presentations of home writers. This is a good illustration of its class.

Theology and the Social Consciousness. A Study of the Relations of the Social Consciousness to Theology, by HENRY C. KING. The Macmillan Co., New York, 1902. pp. 252.

Under the real meaning of the social consciousness for theology are treated, its definition, the inadequacy of analysis to the organism, the ethicizing of religion, and the emphasis upon the historical element. Under the influence of the social consciousness upon theological doctrine are treated, the influence of the deepening sense of the likemindedness of men upon theology, of the mutual influence of men upon it, and the value and sacredness of the person.

The Psychological Elements of Religious Faith. Lectures by Charles C. Everett. Edited by Edward Hale. The Macmillan Co., New York, 1902. pp. 215.

This book is a response to the wish of Dr. Everett's friends that there should be some permanent record of his lectures on theology, the character of which is unique and has made a profound impression. As he left no manuscripts, recourse was had to notes of students. His theological instruction was divided into two courses. The shorter one was on the psychological elements of religious faith. This is comprised in the second volume and is to be followed by another containing the longer course on the subject content of religious faith.

An Essay on Laughter; Its Forms, its Causes, its Development, and its Value, by JAMES SULLY. Longmans, Green & Co., New York, 1902. pp. 441.

The chief chapters are the Smile and the Laugh; Occasions and Cause of Laughter; Varieties of the Laughable; Theories of the Ludicrous; Origin of Laughter; Its development in the First Three Years; the Laughter of Savages; Laughter in Social Evolution; in the Individual or Humor; in Art or Comedy; with a final chapter on the Ultimate value and Limitations of Laughter.

La Mimique, par ÉDOUARD CUYER. O. Doin, Paris, 1902. pp. 366.

The chief chapters are on the muscles of the head; the analysis of expressive movements in face, head, trunk, upper and lower limbs; and finally the synthesis of expressive movements is devoted to characterization of half a dozen feelings and sentiments. There is little attempt at original work and little novelty.

Allgemeine Æsthetik, von JONAS COHN. W. Engelmann, Leipzig, 1901. pp. 293.

The writer treats the content of the field of æsthetic worth, its significance and its limitations, with various subordinate chapters.

The Sensation of Pain and the Theory of the Specific Sense Energies, by ANNA J. MCKEAG. (Experimental Studies in Psychology and Pedagogy, edited by Lightner Witmer.) Ginn and Co., Boston, 1902. pp. 87.

After an analysis of the pain judgment, chapters follow on general judgment, qualitative distinctness and directness, on pain judgment and judgments of other sensations. Part two is devoted to the stimulation of pain, and part three, to an account of pain as a specific differentiation of sense.

Essays Historical and Literary, by JOHN FISKE. 2 vols., pp. 422 and 316. The Macmillan Co., New York, 1902.

These two sumptuous volumes are a pleasure to handle. The material of the first volume was intended to be embodied in a larger work called A History of the American People. Many of the chapters were given as lectures and most had been printed before. The topics are: Thomas Hutchinson, Charles Lee, Hamilton, Jefferson, Madison, Jackson, Harrison, Tyler, Webster, Milton, Huxley, Tyndall, Spencer's service to religion, the Boston Tea Party, Old and New ways of Treating History, the Fall of New France, Evolution and the Present Age, and Koshchei the deathless.

Shakespeare's Portrayal of the Moral Life, by FRANK CHAPMAN SHARP. Charles Scribner's Sons, New York, 1902. pp. 232.

This book is dedicated to Professor Garman, and its chapters are a study of motives, transcendentalism, the criterion of right and wrong, the nature of the good, conscience and the conscienceless, the freedom of the will, virtue and happiness, ethics and metaphysics. It is unfortunate that the author has limited his survey to dramas put in their present form after the close of 1600.

The Mind of Man; a Text Book of Psychology, by GUSTAV SPILLER. MacMillan & Co., New York, 1902. pp. 552.

In the preface we are told that every portion of each chapter is the outcome of research. In the first part, entitled Method, chapters discuss systems as distributed, as organized, as need-satisfying, as redeveloped, as need-determined, and as unified. Part Second, General Analysis. Part third is entitled, General Synthesis, and discusses systems as individualized, classified, and as attention determined.

Grundzüge der physiologischen Psychologie, von WILHELM WUNDT. Vol 2, pp. 686. W. Engelmann, Leipzig, 1902.

The second volume of this thoroughly revised fifth edition contains 153 cuts and 686 pages. As this is probably the last revision of the chief work of the leading modern psychologist, it will long be a standard, and, of course, should be in the possession of every one interested in the subject.

Outlines of Psychology, by WILHELM WUNDT. Second edition. W. Engelmann, Leipzig, 1902. pp. 390. Price, $2.00.

This second English edition includes all that the author has incorporated in the fourth German edition. There are some twenty places which have been more or less extensively rewritten. The work is now a compact and tasteful volume and includes a transcript of Wundt's most important conclusions.

Lehrbuch der Psychologie, von DR. WILHELM JERUSALEM. Wien und Leipzig, 1902. pp. 213.

This handbook follows the general topic of knowledge, feeling and will with a brief appendix on sleep, dreams, hypnotism, and speech disturbances. It is empirical although it lays little stress upon experimental subject matter.

Beiträge zur Psychologie und Philosophie, von GÖTZ MARTIUS. Erster Band, 3. Heft. W. Engelmann, Leipzig, 1902.

Martius's studies are infrequent but very welcome. The present number contains an article by the editor on the duration of light sensations, and another by Hüttner on the psychology of time consciousness with continuous light stimulations.

The Force of Mind or the Mental Factor in Medicine, by ALFRED T. SCHOFIELD. P. Blakiston's Son and Co., Philadelphia, 1902. pp. 309.

Studies from the Yale Psychological Laboratory, edited by E. W. Scripture, Ph. D. Vol. 10, 1902. Yale Univ., New Haven, Conn.

This number of Dr. Scripture's studies contains the following articles: Researches on Rhythmic action, by Ishiro Miyake; researches in experimental phonetics, by E. W. Scripture; experiments on motor education, by W. S. Johnson; involuntary movements of the tongue, by H. C. Courten; phonetic notation, by E. H. Tuttle.

A Dream of Realms Beyond Us, by ADAIR WELCKER. San Francisco, 1902.

This author attempts the modest step of telling us what comes after religion and philosophy and to tell "that which no method of philosophy has yet had in it." It "will create a new vision within earth and cause peace upon earth to come." It is designed to put into the world "that act of the endless world art that will so touch the souls of men that into them will be caused gradually to come from this time on perception and a knowledge of the meaning and purpose of things." Thus "highest manhood in the form of conscience will be caused to come down and to be and dwell upon earth."

Was ist Raum, Zeit, Bewegung, Masse? Was ist die Erscheinungswelt? von JULIUS VON OLIVIER. L. Finsterlin, München, 1902. pp. 153.

The author really offers us here in his greatly enlarged edition a brief system of philosophy, which is evidently the result of a great deal of careful thought. It certainly has a great merit of condensation.

Substanz und Causalität bei Berkeley, von LOUIS A. FREEDMAN. (Dissertation.) Strassburg, 1902. pp. 53.

Earthquakes; Their Origin and Phenomena, by WALTER HALE. 1902. pp. 22.

This writer deliberately takes the view that earthquakes and volcanoes are caused not primarily by internal disturbances in the body of the earth, but by the impact of comets and other invisible bodies striking and plunging into the earth.

L'Association des Idées, par ÉDOUARD CLAPARÈDE. O. Doin, Paris, 1903. pp. 426.

The first part of this book discusses the mechanism of association, its conditions, force, *enchaînement*, form and rapidity. The second part confines the discussion to the mental life, its associations, in sense, memory, intellect and activity.

La Volonté, par FR. PAULHAN. O. Doin, Paris, 1903. pp. 323.

The chapters here are will and automatism, will and suggestion, psychic general facts, the act of will, its evolution from caprice, its domain, its extension, the will spirit from the physiological and the social point of view.

Unitarianism in America; A History of its Origin and Development, by GEORGE WILLIS COOKE. American Unitarian Association, Boston, 1902. pp. 463.

[illegible] one is more competent to write this interesting history [illegible] is a most inspiring theme, the leaders of which [illegible] pioneers in education, reform, charities, statesmanship, literature, and higher criticism. It is a comprehensive, thorough and interesting story told by one who is perhaps as competent as any one in the ranks to deal with such a theme.

Progress in the Clinical Study of Psychiatry. The Study of Principles in Their Application to the Classification of Insanity, by EDWARD COWLES. Reprinted from The American Journal of Insanity, July, 1899.

Treatment of Paresis: Its Limitations and Expectations, by Edward Cowles. Reprinted from the American Journal of Insanity, April, 1902.

Hallucinations and Illusions, by George T. Tuttle. Reprinted from the American Journal of Insanity, January, 1902.

On Certain Studies with the Ergograph, by August Hoch. Reprinted from The Journal of Nervous and Mental Disease. pp. 9.

On the Clinical Study of Psychiatry, by August Hoch. Reprinted from The American Journal of Insanity.

Eighty-Eighth Annual Report of the Trustees of the Massachusetts General Hospital Concerning the McLean Hospital at Waverly, 1901. Barta Press, Boston, 1902. pp. 128.

It is impossible to do justice in the space at our disposal to the extremely valuable work in the study of abnormal and morbid psychology, which this country owes to the initiative of Dr. Edward Cowles, for many years the head of the McLean Hospital and the constructor of the new buildings which make it distinctly the finest in the world. This writer was the leading pioneer in the movement for the training of nurses for the insane and founded the first school. He was one of the first in the country to appreciate the importance of the new or experimental psychology in this work, and nearly twenty years ago took six months off at Baltimore and wrote a memorable and classic study of a case of paranoia. Careful and systematic clinical work has for many years been a specialty at McLean. Now in this institution we find provisions for most careful chemical analyses, for brain pathology and for experimental work, so far as these shed light upon alienation.

We have in the above articles, all of them valuable contributions, specimens of the work done at this institution. Dr. Hoch is one of the best trained and careful workers in his field in the country, with a thorough knowledge of the best that is done and known in Europe; while Dr. Tuttle is perhaps no less expert in clinical work. On the whole, such a unique and harmonious combination of scientific research and of efforts toward more effective and curative care of patients, where each helps the other, has probably never before been made.

Bulletin de la Société libre. Schleicher Freres. Paris, 1902. pp. 200.

The Bulletin de la Société libre pour l'étude psychologique de l'enfant has just completed its second year—eight bulletins having been published. Its avowed object is to further child study from both the pedagogic and purely scientific points of view. It issues questionnaires, collects scientific information and solicits communications from all sources on either individual or collective observations relating to the psychology of childhood. It includes in its bureau of direction The. Ribot, A. Binet and M. F. Buisson, Director of Public Instruction. Edited by Schleicher Freres, rue des Saints-pères 15.

The Hibbert Journal. A Quarterly Review of Religion, Theology, and Philosophy. Vol. I, No. 1. Williams and Norgate, London, 1902. pp. 208.

This stately review is unusually attractive in form. The print of the larger articles is excellent, and the edges are trimmed, something which ought to be required by law in all journals and books, because many are really not worth cutting, and some good matter is lost to those who want it because of the drudgery that is necessary to cut the leaves and to find the place when the edges are rough, so that it cannot be readily thumbed through. The articles are by Percy Gardner on the bases of Christian doctrine; Josiah Royce on the concept of the infinite; the outstanding controversy between science and faith, by Sir Oliver Lodge; Matthew Arnold, by Stopford A. Brooke; "Righteousness of God" in St. Paul's Theology, by James Drummond; early doctrinal modifications of the Gospels, by F. C. Conybeare; catastrophes of the moral order, by (I) G. H. Howison, (II) R. A. Armstrong, (III) R. F. Horton. Nearly one-third of the number and one-half the matter is taken up by reviews of well selected books by eminent writers, and the contents of recent philosophical and theological journals are appended.

The Religion of a Mature Mind, by GEORGE A. COE. F. H. Revell Co., Chicago, 1902. pp. 442.

The writer thinks that the heart of modern man is hungry for a fresh original experience of the Divine, which is something more than a mere reconstruction of doctrine. The personal religious life needs reorganization, for man has come of age. There is a close kinship between human nature and Christianity, which ought to be most scientific, ethical and modern. Christian life must simulate modern progress without sacrificing the inheritance of the past and must assume the immanence of God. Perhaps the best of the thirteen chapters are those entitled modern manhood, the scientific spirit in matters of religion, the moral foundations of spirituality, the breadth of religious experience, the life of prayer.

Religionsphilosophie, von HARALD HÖFFDING. O. R. Reisland, Leipzig, 1901. pp. 369.

The author first discusses the theory of knowledge and its relations to the philosophy of religion. The subject is then treated from a psychological standpoint, including the relations between religious experience and faith, the development of the religious concept, dogma and symbol, the principle of the preservation of worth and of personality. The last part discusses the philosophy of religion from the ethical standpoint.

Can Telepathy Explain? Results of Psychical Research, by MINOT J. SAVAGE. G. P. Putnam's Sons, New York, 1902. pp. 243.

The author does not quite call himself a spiritualist, but he is "strongly inclined to hold the belief in continued personal existence as capable of proof and in the possibility of an at least occasional communication." From this standpoint, he treats the work of the Society for Psychical Research, which he thinks is growing respectable; clairvoyants, apparitions, levitation and telekinesis; gives many fugitive facts; and has certainly written a very readable book, unconvinced as it will leave many who would willingly believe.

Atti dell' XI°. Congresso della Società Freniatrica Italiana. Ancona, 1901. Riv. Sperim. di Fren. (Reggio i. E.), Vol. XXVIII (1902), pp. 1-490. Especially 331-455.

The seventh session (morning of Oct. 3, 1901) of the eleventh Congresso della Società Freniatrica Italiana, held at Ancona, was devoted to the subject of "The Practical Direction which psychiatry can give to Pedagogy." The paper was read by Professor Cesare Agostini of Perugia and discussed by Drs. Montesano, Del Greco, Bianchi, Obici, etc. The present system of education, is itself one of the most important factors of mental disease, since it devotes itself almost entirely to an intensive cultivation of the intelligence, without a corresponding physical and moral education. Bonfigli was right in saying that defective education in childhood, particularly in relation to the evolution of the moral sense and the formation of character, is one of the most powerful social factors of mental alienation. The school has been long enough under the illusion that by instruction a character can be created out of hand, a process leading only to mental decadence. The psychiatrist, who not only studies the anomalies and the diseases of mind, but seeks, as far as possible, to prevent them, from the opportunities he has had of observing the evil effects of imperfect and erratic pedagogical ideas upon the mental health of children, can suggest to the teacher the practical norms by which he can recognize and remove in time the bad results of excessive and untimely mental work, particularly in those who, for hereditary and pathological reasons, are predisposed to disturbances of the intellect, feelings and will. Instruction must be fitted to the development and the mental capacity of the child, to the degree of sensitiveness, to the power of instincts and emotions. The normal education of those senses must be facilitated which directly influence intellectual and moral development and make for character. For real intellectual and moral education a proper basis of physical education must be provided and a normal evolution with a physiological validity of the cerebral activities established. To do this the teacher must know something about children in general and about his pupils in particular. He must know the general facts and conclusions of psychology and anthropology, normal and pathological, and must have the assistance of a medical inspector, preferably of psychiatrical training and experience, who will be able to detect in their early stages those anomalies and defects, mental and physical, which, if not at once attended to, will endanger in later life the health or the sanity of the pupils concerned. Thus oriented from the practical experience of psychiatry, pedagogy will be better able to go about its task of preparing the individual, according to his psycho-physical aptitudes, for activity in the various branches of science, art and industry having made him more fit to survive in the struggle for life and more capable of profiting by his social environment.

In the discussion Dr. Bianchi wisely said that the attempt to create an absolute norm by physical diagnosis and anthropometric evidence and to infer from such data moral disposition, etc., was fraught with great danger, for many who presented numerous and marked stigmata of degeneration are endowed with intellectual powers and moral qualities superior to those of individuals much better constituted physically. A mediocre knowledge of physiology and psychology is a dangerous equipment for a teacher, and perhaps, after all, the medical inspector should be the diagnoser.

Dr. Obici emphasised the necessity for educating the sexual instincts, a matter which he and Dr. Marchesini have already treated in their book on collegiate loves and friendships.

At the time of puberty sexual instinct and emotions have a chief rôle in the formation of the morals and social feelings of the individual. The bad education of puberty is responsible for many of the "orgies" of love.

Dr. Obici also read a paper on "The Influence of Prolonged Intellectual Labor and Mental Fatigue upon the Respiration," which is to be published in full in a future number of the Rivista. His chief conclusions are that prolonged mental labor (arithmetical calculation) produces great irregularities of respiration, increases its frequency, induces more numerous and intense variations in depth, and decreases the length of the inspiration and of the post-inspiratory pause, increasing the duration of the expiration and its pause.

The rest of the morning and the eighth session (afternoon of Oct. 3) of the Congress were occupied with the consideration of "Criteria and Methods for the Educability of Defectives and Dements." The paper was read by Dr. De Sanctis, the well-known alienist and psychologist, who spoke with some detail of defectives (pathogenesis and classification of the feeble-minded, their educability), means and methods of education, etc. Dr. De Sanctis's chief conclusions are: All such defectives are potentially anti-social, and at certain times of their life most of them actually become so. There is no doubt as to certain intellectual and moral educability upon a scientific basis of most of these defectives. But the degree of educability is very variable, and intellectual and moral educablity are not always on the same level. Neither follows always a straight line of continuous improvement, but undergoes often retardations, arrests and regressions. Other than biopathological factors limit in some cases the degree of educability, and act unfavorably upon the ascending line of educational progress. The anti-sociality of so many of defectives is due to the arrest which so often takes place at the end of childhood or during adolescence. Factors contributing to this are the initiation of the struggle for life, diminution of family supervision, possibility of intoxication (alcoholic especially), readiness of criminal suggestions, development of nervous and mental diseases peculiar to adolescence, and most powerful of all, puberty and the awakening of the sexual instinct. Defectives and feeble-minded must be protected in adolescence and in youth,—and for them, as for normal individuals an "integral" education is justly demanded. There is but one efficacious means of education, *work*. This is to be applied in diverse forms according to the age, bio-pathological conditions, family relationship and social conditions of every individual defective. Farm-colonies, industrial schools, distribution of defectives among the families of farmers in the open country, etc., are all of value. The principle of individual education must be above all adhered to.

In his interesting article on "'Mental Tests' in the Schools," Dr. Ugo Pizzoli, the director of the Crevalcore Laboratory of Scientific Pedagogy, gives an account of a piece of apparatus devised by him for mental and psycho-physical tests. By means of this instrument, the chief part of which consists of five rectangular metal plates, whose serrated edges come into contact in such a way as to form figures containing all the graphic elements of writing (straight lines, curves, horizontal, oblique and vertical lines, angles, etc.) the pupil with pencil, electric attachment, etc., can go through the psychic actions and motor activities involved in the elements of writing. The records thus obtained serve for both normal and defective children a new and valuable "mental test." By means of this instrument "pre-education" in writing is possible. The apparatus educates the eye of the child and teaches him to co-ordinate the muscles used in such exercises. Its simplicity, adaptability and variability make this apparatus a distinct aid to graphological education. By means of this new pedagogical appliance kindergarten pupils have learned to write in 15 days, as compared with a month by the old method. Comparing the writing, after five months of school of these two sets of children that of those who used the new apparatus was found to be much better. It would appear that Dr. Pizzoli's device could be made use of much in elementary education. A. F. CHAMBERLAIN.

A Plan for the Study of Man with reference to bills to establish a laboratory for the study of the criminal, pauper, and defective classes, with a bibliography of child study, by ARTHUR MCDONALD. Govt. Print, Washington, 1902. pp. 166.

This is an interesting and valuable outline in which the author abridges some of his old studies and adds new ones in order to show the great service which such a laboratory as he desires to establish could render. His persistent advocacy of this cause deserves great praise and is sure to be successful in the end.

Journal für Psychologie und Neurologie. Band I, Heft 1 & 2. J. A. Barth, Leipzig, 1902. pp. 88.

In this new journal, in which the Zeitschrift für Hypnotismus has been merged, we have first a general article by Forel on the justification of comparative psychology and its objects; then a long plethysmographic study with eight plates by Brodmann on the volume of the brain and forearm of men in sleep; a briefer study of muscle tonus with special relation to the cortex; and book notes.

Vom Fühlen, Wollen und Denken, von THEODOR LIPPS. J. A. Barth, Leipzig, 1902. pp. 196.

In this psychological sketch, three fundamental contrasts between feelings are characterized. Chapters are devoted to feelings of effort; the consciousness of reality; the laws of effort; feelings and endeavors conditioned by association; wishing, willing, and purposive activity; feelings of quantity and worth; the kinds of feeling relation; objective values and oughtness. No psychologist need be told that this long expected work is of the greatest value and acumen.

Annual Report of the Board of Regents of the Smithsonian Institution for the year ending June 30, 1900. Report of the United States National Museum. Govt. Print, Washington, 1902. pp. 738.

In this report besides the report of the Assistant Secretary, head Curators, summary of operations, seven interesting papers are appended illustrating collections in the Museum, viz.: W. H. Holmes on anthropological studies in California; O. T. Mason on aboriginal American harpoons; A. E. Hippisley on ceramic art in China; C. K. Wead on contributions to the history of musical scales; Walter Hough on Hopi ceremonial pigments; Wirt Tassin on the gem and meteorite collections of the Museum.

Benoit de Spinoza, par PAUL-LOUIS COUCHOUD. F. Alcan, Paris, 1902. pp. 305.

The leading chapters are: the synagogue, the conversion, formation of the theory of substances, early writings, the principles of Descartes's philosophy, works on theology and politics and ethics.

SUBJECT INDEX.

Æsthetics, 324, 580.
Animal Intelligence. See Comparative Psychology.
Anthropometry, 587.
Anthropology. Borneo head-hunters, 575; First steps in human progress, 323; Kathlamet texts, 456; Primitive family, 323; Psychology of primitive peoples, 578. See also Ethnology and Folk-lore.
Association, 582; Associations of numerals, 450.

Belief, 451.
Biology: Theoretical biology, 323. See also Evolution and Consciousness.
Birds: Song of birds, 321; songs, migrations and other habits, 457.

Children: Child culture, 578; Childhood of Jesus according to Luke, 170; Children's ideas of the moon, 294; Child language, 577; Children's logic, 322; German translation of Pres. Hall's essays on child study, 577; Play, 577; Société libre pour l' étute psychologique de l'enfants, Paris, 583; Suicide of children, 322. See also Temperaments.
Colors, relation of saturation and area, 481; Color threshold in discrete and continuous areas, 485. See also Fechner's colors.
Comparative physiology of the lower animals, 576.
Comparative psychology: Animal intelligence, 171; Habits of fishes, 408; Industries of animals, 322; Monkeys, 98, 173; Observations upon birds, 457; Song of birds, 321. See also Evolution.
Consciousness in its biological aspects, 455.

Defectives, 586, 587.
Discrimination of clangs and tones, 219.
Dreams, 451, 454.

Education and psychiatry, 585; educational statistics (of the west), 577.
Emotion, 62; Old Swabian love letters, 172. See Laughter, Religion and Sex.
Ergographic studies, 583.
Essays, Baldwin, 454; van Biervliet, 453; Fiske, 581; Pearson, 453; Spencer's "Facts and Comments," 452; The hearts of men (Fielding), 577.
453; English Utilitarianism, 453; Shakspere and the moral
581.
y: European peoples, 578. 19th Annual Report of the
u of American Ethnology, 579; Racial psychology, 578. See
thropology.
f mind, 171, 576, 578.
movements, 580.

olors, 488.
Wundt's), 575.
the moon, 294. See also Anthropology.
453: memorial papers of Lewis G. Janes, 323.

pulse, 364.
on psychology: Lipps, 587. Wundt's Grundzüge. (5th
See also Essays and Text books.

"Genetic modes," 576.
Grammar of science (Pearson), 453.
Graphology, 453.

Hallucinations and illusions, 583.
Handwriting and character, 453.
Hibbert Journal, 584.
Hypnotism, experimental and therapeutic, 456. See also Christian science.

Images, 526; visual, 527; motor, 537; auditory, 541; dermal, gustatory and olfactory, 544; direction of images, 547.
Impulses and obsessions, 579.
Individual psychology, 149.

Language of children, 577.
Laughter, 453, 580.

Magic and religion, 451.
Martius's *Beiträge*, 581.
Memory image: memory image and judgments of tones, 219. See also Images.
Mental arrangement, 269; mental complexes, 269; mental factor in medicine, 582; mental growth and control, 323; mental growth and decay, 426; mental images, 526; mental tests, 586.
Mental types, 579; Analytical and synthetic types, 578. See also Temperaments.
Meter, see Rhythm.
Michigan Studies, 1.
Military psychology, 171.
Mimetic movements, 580.
Mind and brain, 169; mind and body, 171; mind in evolution, 578; mind of the child, 578.
Miscellaneous: "A Dream of Realms Beyond Us," 582. Capillarity in plants, 172. Earthquakes, their origin and phenomena, 582. Huxley, biography by Clodd, 454. Lewis G. Janes, memorial papers, 323. Report of the Massachusetts General Hospital, 583; Smithsonian Report 1899–1900, 587.
Morbid, see Psychiatry.
Multiplex personality, 323.
Music and psychology, 169.

Neurological: Anatomy of the central nervous system (Obersteiner), 454; Cerebral localization, 169: Nerve cells and cells in general, 455; Neurological technique, 171.
Number, 88; Number forms and similar phenomena, 355.

Obsessions and impulses, 579; and psychasthenia, 579.
Occultism and spiritism, 323, 324; Pathology of occult phenomena, 579.

Pain and specific energies, 580.
Personality. See Multiplex personality.
Philosophical: Année philosophique, 456: A scientific philosophy, 321; Anselm, 170; Baldwin's Dictionary of Philosophy and Psychology, 576; Berkeley on substance and causality, 582; Boethius (tr. by Cooper), 455; Kant's Prolegomena (tr. by Carus), 320, 454; Leibnitz (tr. of portions of his works by Montgomery), 321, 454; Ontology, 172; Outlines of metaphysics (MacKensie), 319, 455; Philosophy of religion, 584; Schopenhauer, 172: Space, time, movement, the external world, 582; Spinoza, 587; The World of Art, 324; Wundt's philosophy and psychology, 451.

NAMES OF AUTHORS.

(The names of those who have contributed original matter are printed in SMALL CAPITALS.)

Aikins, Herbert A., 585.
Albee, Ernest, 453.

Baer, A., 322.
BAGLEY, FLORENCE W., 488.
Baldwin, J. Mark, 454, 576.
Bartholomew, E. F., 169.
Bawden, H. Heath, 324.
BELL, SANFORD, 325.
BENTLEY, I. M., 161, 269.
van Biervliet, J. J., 453.
Binet, Alfred, 584.
Boas, Franz, 456.
Bos, C., 451.
BUCHNER, EDWARD F., 355

Calkins, Mary Whiton, 161.
Campeano, M., 171.
Carr, Harvey A., 577.
Carus, Paul, 320, 454.
Chamberlain, A. F., 585.
Claparède, Edouard, 582.
Clodd, E., 454.
Coe, George A., 584.
Cohn, Jonas, 580.
COLVIN, STEPHEN S., 80.
Cooke, Geo. Willis, 582.
Cooper, W. V., 455.
Couchoud, Paul-Louis, 587.
Coupin, H., 322.
Cowles, Edward, 583.
Currier, Andrew F., 321.
Cuyer, Edouard, 580.
von Czobel, Stefan, 321.

Dawson, W. J., 170.
Dugas, L., 453.

Ebbinghaus, Hermann, 169, 575.
Eisler, R., 451.
Encausse, G., 324.
Everett, Charles C., 580.

Fielding, H., 577.
Fischer-Dückelmann, A., 172.
Fiske, John, 581.
Flournoy, Th., 323.
Fouillée, Alfred, 578.
FRANCE, CLEMENS J., 364.
Freedman, Louis A., 582.
Frothingham, Arthur L., 172.
Fullerton, George S., 170.
Furness, Wm. H., 575.
von Furth, Otto, 576.

Gilbert, George H., 321.
Goppelsroeder, Fried, 172.
Gunkel, Hermann, 455.
GURLEY, REVERE R., 408.

Haecker, Valentin, 321.
Hale, Walter, 582.
Hall, G. Stanley, 577.
Hardesty, Irving, 171.
HAYES, SAMUEL P., 550.
Hellwig, Bernhard, 322.
Hillman, Johannes, 170.
Hobhouse, L. T., 578.
Hoch, August, 583.
Höffding, Harald, 584.
Hollander, Bernard, 169.
Hutchinson, H. G., 451.

Janes, Lewis G., 323.
Janet, Pierre, 579.
Jerusalem, Wilhelm, 581.
Jung, C. G., 579.

Kellor, Frances A., 171.
King, Henry C., 580.
KINNAMAN, A. J., 98, 173.
Kronthal, Paul, 455.

Lang, Andrew, 451.
Lechalas, Georges, 324.
Leighton, Joseph A., 324.
LIBBY, O. G., 457.
Lipps, Theodor, 587.

MacDonald, A., 587.
MACDOUGALL, ROBERT, 88, 477.
McKeag, Anna J., 580.
Mackenzie, John S., 319, 455.
Mach, E., 171.
Malapert, D., 579.
MARBE, K., 450.

Martius, Götz, 581.
Mayor, Joseph B., 170.
Meumann, Ernst, 577.
Meyer, G., 453.
Mills, Wesley, 171.
Minot, Charles Sedgwick, 455.
Montgomery, George R., 321, 454.
MOORE, R. M., 320.
Müffelmann, Leo, 456.
Münsterberg, Hugo, 576.

Obersteiner, Heinrich, 454.
Oertel, H., 450.
v.Olivier, Julius, 582.
Oppenheim, Nathan, 323.

Patten, Simon N., 172.
Paulhan, Fr., 323, 578, 582.
Peabody, Frederick W., 323.
Pearson, Karl, 453.
Pieron, H., 454.
PILLSBURY, W. B., 1.
Pitres, A., 579.
Price, Orlo J., 579.

Queyrat, Frédéric, 322.

Regis, E., 579.
Reinke, J., 323, 324.
Riddell, Newton N., 578.
Ritter, Albert, 172.
Robinson, Byron, 172.

SANFORD, EDMUND C., 426.
Savage, G. C., 324.
Savage, Minot J., 584.
Schofield, Alfred T., 582.
Schultze, Fritz, 578.
Scripture, E. W., 582.
SEARS, CHARLES H., 28.
Sharp, Frank C., 581.
Sidis, Boris, 579.
Sikorsky, J. A., 578.
SLAUGHTER, J. W., 294, 526.
Spencer, Herbert, 452.
Spiller, Gustav, 581.
Starcke, C. N., 323.
Starr, Frederick, 323.
Steingiesser, F., 172.
STEVENS, H. C., 1.
Sully, James, 580.

Thomas, J. W., 171.
TRIPLETT, NORMAN, 149.
Tuttle, George T., 583.

Vaschide, N., 454.
Volkelt, Johannes, 172.
de Vorges, Domet, 170.

Wait, Charles E., 172.
Welcker, Adair, 582.
WHIPPLE, GUY M., 219.
WOOLSTON, H. B., 62.
Wundt, Wilhelm, 575, 581.

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